The Engineer.

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VOL. CLII.—No. 3957] LONDON: FRIDAY EVENING, NOVEMBER 13, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

Armourers' and Brasiers' COMPANY, in the City of London.

LECTURES IN METALLURGY.

The COMPANY have ARRANGED for COURSES of THREE LECTURES to be delivered as follows :—

At the ROYAL SCHOOL OF MINES, Prince Consort road, South Kensington, at 8 p.m., on MONDAYS, 16th, 23rd and 30th NOVEMBER, 1931, by

Dr. COLIN J. SMITHELLS, M.C., D.Sc.,
on
METALLURGY IN THE ELECTRICAL INDUSTRY.

At the INSTITUTION OF CIVIL ENGINEERS, Great George-street, Westminster, at 6 p.m., on THURSDAYS, the 26th NOVEMBER, and the 3rd and 10th DECEMBER, 1931,

by

PROFESSOR CHARLES E. INGLIS, O.B.E., M. Inst. C.E., F.R.S.,
on
"VIBRATIONS IN RAILWAY BRIDGES AND IMPACT ALLOWANCES."

Admission Free, without Ticket. 7763

Northampton Polytechnic INSTITUTE, ST. JOHN-STREET, E.C. 1.

APPLICATIONS are INVITED for the POST of LECTURER in MECHANICAL ENGINEERING.

Candidates should be of good academic standing and should have had suitable practical experience in Mechanical Engineering. Qualifications for advanced teaching in Heat Engines are essential.

Salary in accordance with the Burnham Scale for Graduate Teachers in Technical Institutions in London, less 10 per cent.

Conditions of appointment will be sent on request.

Applications should be received by 25th November.

S. C. LAWS, M.A., M.Sc., Principal.

7769

The Midland Branch of the INSTITUTION of MECHANICAL ENGINEERS would be glad to HEAR from MANUFACTURERS who are WILLING to LOAN FILMS (silent) dealing with subjects of interest to Mechanical Engineers for exhibition at a meeting to be held by the said Branch on March 3rd, 1932. 7772

Borough of Chepping Wycombe WATERWORKS UNEMPLOYMENT RELIEF SCHEME.

4IN. AND 6IN. DIA. STEEL MAINS. SUPPLY OF PIPES.

TENDERS are INVITED from experienced British Manufacturers for the SUPPLY and DELIVERY at High Wycombe Station of about 8200 YARDS of 6in. and 2517 YARDS of 4in. STEEL PIPE, Coated and Double Wrapped, together with the necessary SPECIAL PIPES and BENDS.

Copies of the specification, bills of quantities, and form of Tender may be obtained from Mr. S. Young, Water Engineer, 71, Easton-street, High Wycombe, upon depositing the sum of £2, which will be returned on receipt of a bona fide Tender.

The manufacturers will be required to observe the conditions relating to the employment of labour imposed by the Unemployment Grants Committee and to undertake to commence the manufacture of the pipes immediately.

Sealed Tenders, marked "Tender for Pipes," must be received by the undersigned not later than first post on the 30th November, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

PHILIP B. BEECROFT, Town Clerk.

High Wycombe, 10th November, 1931. 7782

County Borough of Swansea. ELECTRICITY DEPARTMENT.

SUBAQUEOUS TUNNELS AND SHAFTS, DOCK INTAKE AND DISCHARGE AND FOUNDATIONS FOR POWER STATION AT TIR JOHN NORTH.

The Corporation invite TENDERS for the CONSTRUCTION of the above, and other incidental Works.

The works are unemployment relief works, and will be subject to conditions laid down by the Government Unemployment Grants Committee.

On and after Monday, 16th November, 1931, plans may be seen and general conditions, specification, form of Tender and quantities obtained at the office of the Engineers, Sir Cyril Kirkpatrick and Partners, 25, Victoria-street, Westminster, S.W. 1, on deposit of Ten Guineas, which will be returned on receipt of a bona fide Tender (not subsequently withdrawn).

Tenders must be received by the undersigned not later than Twelve Noon on the 16th December, 1931.

The lowest or any Tender will not necessarily be accepted.

H. L. LANG-COATH, Town Clerk.

Guildhall, Swansea, October, 1931. 7737

Borough of Chepping Wycombe WATERWORKS UNEMPLOYMENT RELIEF SCHEME.

4IN. AND 6IN. DIA. STEEL MAINS. MAIN LAYING.

TENDERS are INVITED from experienced Contractors for the CARTING, LAYING and JOINTING of about 8200 YARDS of 6in. and 2517 YARDS of 4in. STEEL PIPE (supplied by the Corporation), together with the PROVISION of the SLUICE VALVES, AIR VALVES and HYDRANTS in the above Borough and the Wycombe Rural District.

Drawings may be seen at the office of Mr. S. Young, Water Engineer, 71, Easton-street, High Wycombe, and copies of the specification, bills of quantities, and form of Tender may be obtained from him upon depositing the sum of £2, which will be returned upon the receipt of a bona fide Tender.

The works are to be carried out in strict accordance with the conditions as to materials and labour laid down by the Unemployment Grants Committee in respect to employment schemes, and the contractor will be required to undertake to commence the works not later than the 31st December next.

Sealed Tenders, marked "Tender for Main Laying," must be received by the undersigned not later than first post on the 30th November, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

PHILIP B. BEECROFT, Town Clerk.

High Wycombe, 10th November, 1931. 7781

The Engineer

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PUBLIC NOTICES.

The Manchester Steam Users' ASSOCIATION.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.

Founded 1854 by SIR WILLIAM FAIRBAIRN.

Certificates of Safety issued under the Factory and Workshops Act, 1901. Compensation for Damages and Liabilities paid in case of Explosions. Engines and Boilers Inspected during construction. 6762

The Institution of Chemical ENGINEERS.

EXAMINATION, 1932.

Application Forms (returnable 21st December, 1931) and Particulars of the ASSOCIATE-MEMBERSHIP EXAMINATION for 1932, together with the MEMORANDUM on "The Training of a Chemical Engineer," may be obtained from the HON. REGISTRAR, Institution of Chemical Engineers, Abbey House, Westminster, London, S.W. 1. 7791

Derby Corporation. SEWAGE DISPOSAL WORKS EXTENSIONS, 1931.

CONTRACT NO. 3.—PUMPING MACHINERY.

The Corporation invite TENDERS for FIVE PUMPING UNITS, consisting of Centrifugal Pumps actuated by Electric Motors, together with Pipes, Valves and other Fittings.

The drawing may be seen and copies of the specification and bill of particulars may be obtained at the office of the Engineers, James Mansergh and Sons, 5, Victoria-street, Westminster, London, S.W. 1, on and after Monday, November 16th, on the deposit of a cheque for £5, which will be returned after the receipt of a bona fide Tender with the bill of particulars, &c., fully priced out.

Early application for particulars is desirable, as only a limited number will be given out.

Sealed Tenders, addressed to me and endorsed "Derby Corporation, Sewage Disposal Works Extensions, Tender for Contract No. 3," are to be delivered at my office (post paid) at or before Noon on Tuesday, December 8th, 1931.

The Corporation do not bind themselves to accept the lowest or any Tender.

G. TREVELYAN LEE, Town Clerk.

Town Clerk's Office, Market-place, Derby. 7779

PUBLIC NOTICES.

London County Council.

TENDERS are INVITED for SUPPLY and DELIVERY in London of :—TRAMWAY RAILS, &c., in 1932-33 :

(1) SECTION A.—About 3140 TONS of TRACK RAILS, GUARD RAILS and FISH-PLATES.

SECTION B.—About 35 TONS of FISH BOLTS and NUTS.

(2) About 700 TONS of CONDUCTOR TEE RAILS.

(Tenders will be considered for separate sections.)

The specifications, forms of Tender, drawings, &c., obtainable from General Manager of Tramways, 23, Belvedere-road, S.E. 1, upon payment of £2, in each case, i.e., (1) and (2) by cheque or draft to the order of the Council. This amount returnable only if tenderer shall have sent in a bona fide Tender, and shall not have withdrawn same. Full particulars of the work obtainable on personal application, and contract documents may be inspected before payment of fee. Correspondence and remittances by post to be addressed to the General Manager of Tramways, 23, Belvedere-road, S.E. 1, or personal application may be made to Room 222 at above address in respect of item (1) (Sections A and B), and to Room 202 in respect of item (2).

Contractors will be bound to observe provisions of fair wages clause, the terms of which are set out fully in instructions for Tender and forms of contract, and in "The London County Council Gazette."

No Tender received by CLERK OF THE COUNCIL at The County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 30th November, 1931, will be considered.

The Council does not bind itself to accept lowest or any Tender. 7766

NOTICE TO FOREMEN.

The National Foremen's Association is an Association of Foremen formed to represent them on all questions affecting their supervisory interests.

For full particulars apply, GENERAL SECRETARY, 95, Belgrave-road, Westminster, S.W. 1. 7608

PUBLIC NOTICES.

London County Council.

TENDERS are INVITED for EXTENSION of existing BRIDGE carrying High-road, Lee, over river Quaggy. Contract provides for Removal of Paving where necessary and of Superstructure carrying Footway on south side of existing Bridge, Construction of Brick-faced Concrete Abutments, Supply and Erection of Steel Girders and Construction of Concrete Superstructure. During progress of work facilities for vehicular and pedestrian traffic must be maintained and arrangements made for carrying flow of river Quaggy.

Specification, form of Tender, &c., may be obtained on and after 16th November from Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £2 by cheque, draft or money order to order of the Council. This amount will be returnable only if tenderer shall have sent in a bona fide Tender and shall not have withdrawn same. Full particulars of the work may be obtained on personal application, and contract documents may be inspected before payment of fee.

Remittances by post should be addressed to Chief Engineer, Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

Contractor will be bound to observe provisions of a fair wages clause, terms of which are set out fully in instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by Clerk of the Council at County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 30th November, will be considered.

The Council does not bind itself to accept lowest or any Tender. 7778

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

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THE PROPRIETOR of BRITISH PATENT No. 218,551, dated November 14th, 1923, relating to "Improvements in Removable Truck Bodies," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 7761 H

THE PROPRIETOR of BRITISH PATENT No. 282,641, for "Improvements in Arrangements for Transforming Rotary Movement into a Striking or Hammering Movement," is DESIROUS of ENTERING into NEGOTIATIONS with interested parties for the GRANTING of LICENCES thereunder on reasonable terms, or for the SALE of the PATENT outright.—Communications please address to Messrs. DICKER, POLLAK and MERCER, Chartered Patent Agents, 20-23, Holborn, London, E.C. 1. 7762 H

THE PROPRIETOR of BRITISH PATENT No. 284,675, for "Automatic Means for Stabilising Bodies Travelling under Water," DESIRES to ENTER into ARRANGEMENT by way of LICENCE or OTHERWISE for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.

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MISCELLANEOUS

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A Seven-Day Journal

British Cast Iron Research.

In the tenth annual report of the British Cast Iron Research Association, presented at a meeting held last Wednesday, November 11th, when Mr. H. B. Weeks was again re-elected as chairman of the Council, the work of the Association during the past year is described. It is interesting to note that over eighty member-firms, nominating more than one hundred persons, are now represented on the Council and Committees. Many researches were continued or begun during the year. That upon moulding sands and refractories was devoted in particular to the application of principles discovered in the research to practical foundry conditions. In this connection fifty-three foundries were visited during the year in connection with moulding sand problems. The investigation of the heat-resisting and other properties of the high silicon cast iron developed by the Association and known as Silal, was continued, and another alloy, known as Nicrosilal, containing nickel and chromium and having in some respects better properties than the former iron, was developed. The investigations of cupola melting practice were continued and five cupolas of the soft-blast type, evolved by the Association, ranging in output from 2·5 to 12 tons per hour, were made and installed in England. During the year important research reports were issued on nickel-silicon, chromium-silicon and manganese-silicon cast irons. They covered, it is claimed, the most comprehensive results yet issued on these alloys. Some 350 problems received from members were dealt with, involving the issuing of about 400 reports. At the end of the year under review, arrangements with H.M. Government, by virtue of which the Association obtained pound for pound grants on industrial subscriptions, came to an end, and a new scheme came into existence as from July 1st, 1931, by which a grant is only to be paid at the rate of pound for pound on subscriptions totalling over £5000 per annum. The unfortunate coincidence of this change with the profound financial crisis through which the nation is passing is noted in the report.

The Thames Transmission Line Crossing.

Particulars have just been issued by the Central Electricity Board concerning the towers to be used for the Thames crossing at Crossness, where the Board's Barking-Swanscombe 132 kV line will pass over the river. One tower will be erected at Horse Shoe Corner, on the North bank of the Thames, near Dagenham Dock, and the other on the South bank, adjacent to the L.C.C. drainage works, Southern Outfall. The towers will carry six conductors and an earth wire, which will be electrically connected to the earthed towers. The span will be approximately 3060ft. At the base the towers will be about 120ft wide. Both towers will be composed of rolled steel sections, and the cross arms and tower tops, down to some 20ft. below the bottom cross arm, will be galvanised and bolted, whilst below this point the steel work will be ungalvanised, riveted and painted. Each cross arm will be provided with a rail from end to end, outside the tower framework, designed to carry a travelling chair suspended from a set of grooved wheels, so that the chair may be used for maintenance purposes. Platforms will be provided approximately 8ft. below each cross arm and railed steel ladders, broken by railed platforms, approximately 50ft. apart, will extend from the ground level to the inside of the tower peak. Provision is to be made for the future accommodation of lifts running up the centres of the towers to the level of the bottom cross arms. The height of the towers will be 490ft., giving a clearance between the line conductors and the mean high water level spring tides of 250ft.

Electricity Supply in Home Counties.

According to a report published during the past week, arrangements are approaching completion for the taking over by the London and Home Counties Joint Electricity Authority of the electric light and power undertaking of the South Metropolitan Electric Tramways and Lighting Company, Ltd. When the arrangement comes into force, it will consolidate the Mid-Surrey and Middlesex schemes of the authority, embodying an area stretching from Twickenham to Dorking in one direction, and from Carshalton to Woking in the other. Already the authority is supplying electricity in bulk to the whole of the area, with the exception of the 50 square miles which have been the subject of negotiation with the South Metropolitan Electric Tramways and Lighting Company, and is said to have reduced the price to the consumers by 12½ to 33⅓ per cent. In the district to be absorbed there are approximately 20,000 consumers. The area concerned includes Sutton, Cheam, Beddington, Wallington, Carshalton, Banstead, Walton-on-Thames, Kingswood, Ewell, Chipstead, and portions of the Reigate Rural district. The scheme provides for the formation of a joint electricity authority from the London and Home Counties Joint Electricity Authority, and the local government bodies of the area and the Authority would take over the whole of the South Metropolitan Electric Tramways and Lighting Company's undertaking, apart from the tramways, including the plant and staff. Possibly, the transfer may be completed by January 1st, 1932, but the approval of the Electricity Commissioners is required, and if the preliminaries cannot be carried through by the end of the year, the transfer will be deferred to July 1st, 1932.

Dock Extension Progress at Southampton.

Very satisfactory progress, we learn, continues to be made with the dock extension work and the construction of the new graving dock at Southampton. Since the work was begun, no less than 4,250,000 cubic yards of soft mud have been dredged out in preparation for the deep-water channel and have been dumped at sea, while a further 3 million cubic yards have been lifted and used for the new embankment and the reclamation of land. Up to date 37 acres have been converted into firm, dry land, in addition to the 18 acres near the Royal Pier, which is now employed as a contractor's yard. Over 1000ft. along the new deep-water quay wall frontage have been dredged to a depth of 45ft., while the seventy-eight monoliths forming the first 3800ft. of the new quay are now sunk to depth, and the work of building the superstructure has been begun The foundations for the four passenger and cargo sheds, which form the first part of the scheme, are now finished, and the construction of the actual buildings will shortly be started. With regard to the work falling under the second part of the dock extension scheme, upwards of a million cubic yards of soft mud have now been dredged from the continuation of the deep-water channel, and have been dumped at sea, while about half that amount of material has, in the form of firm soil, been employed for building enclosing banks. The main reclamation bank for the second section of the scheme has now been completed for a length of 2000ft., and work on the other 1500ft. is proceeding rapidly.

Water Softening Plant for the Railways.

As a result of a special inquiry initiated in November, 1930, twenty-eight water softening plants of the lime-soda type are being erected at various points on the two main lines between Euston and St. Pancras, on the London, Midland and Scottish Railway, and Carlisle. The present water supplies in the Southern districts of the L.M.S. are generally hard, temporary hardness being a noticeable feature. In the Midlands also the waters are hard, but there both temporary and permanent hardness are high. Further north, the supplies are of better quality, with marked exceptions in the case of certain industrial areas. The present mean hardness in England is approximately 15 deg., but there are many important supplies of a hardness of 20 deg. to 25 deg. Investigations indicate that very substantial economies, particularly in boiler maintenance costs, are to be anticipated if the average hardness of the water used for locomotives can be reduced from the present figure of 15 deg. to 4 deg. or 5 deg. Full consideration has been given to the relative merits of external treatment in water-softening plants as opposed to internal treatment in the actual boilers, and it is realised that each method has its appropriate field. Where water is used in sufficient quantity, rendering treatment in plants relatively cheap, the results obtained by preventing solid matter from entering the boilers would seem to be superior to those due to a change in the character of the deposit, which is all that internal treatment can effect. On the other hand, on less important sections of the line the capital cost of installing fixed plants would be prohibitive, and under these circumstances a suitable internal treatment, if available, should effect valuable economy.

The Monarch of Bermuda.

On Friday last, November 6th, the newly completed turbo-electrically propelled liner, the "Monarch of Bermuda," arrived in the Firth of Clyde for trials, having made the voyage round from the Tyne. The ship left the Tyne on Wednesday morning and was given a remarkable send-off by the Tyneside people. She was built at the Walker Naval Yard of Vickers-Armstrongs, Ltd., and will be employed in the bi-weekly service of the Furness Line between New York and Bermuda and for cruises. After compass trials the new liner proceeded north by way of the Pentland Firth, and the West Coast for the Clyde, and in the stormy weather she exhibited the excellent qualities of seaworthiness which were to be expected from her special hull design. She has a length of 576ft., a beam of 76ft. 6in., and a depth to "C" deck of 43ft. 3in., her measurement being about 20,500 gross tons. Throughout the voyage round and her subsequent measured mile and endurance trials the boilers and propelling machinery gave the highest satisfaction, the specified conditions being more than fully satisfied as regards speed, fuel consumption, and ease of manœuvring. A speed of over 20 knots was developed on the measured mile at Skelmorlie. The main propelling machinery comprises two 7500 kW turbo-alternators, each of which supplies current to a 4650 S.H.P. 150 r.p.m. motor on two of the four propeller shafts. Steam is generated in eight Babcock and Wilcox water-tube boilers at a pressure of 400 lb. per square inch, and a superheated steam temperature of 650 deg. to 675 deg. Fah. The engine-room and deck machinery is mostly electrically operated, there being two 750 kW turbo-generator sets in addition to a 45 kW emergency oil-engine driven set. Accommodation has been provided for 830 first-class and thirty second-class passengers in single berth, two and three-berth state-rooms, and the public rooms are decorated in the most modern style. The propelling machinery was designed and built by Vickers-Armstrongs' marine engineering department in conjunction with the General Electric Company, Ltd., of Witton, Erith and London.

The Reorganisation of the Royal Mail Group.

According to our contemporary journal, *The Shipping World*, the scheme of reorganisation of the Royal Mail group of shipping companies has now been completed, and is being considered by the financial and other interests concerned. The intention of the voting trustees is apparently to adopt a policy of decentralisation, which will embrace the formation of smaller groups on a geographical basis. These groups will probably be associated with the Atlantic, South American, West, South and East Africa, and the Australian and New Zealand trades, as well as the Coastal Lines. Each of the companies will be under the control of an experienced management, with knowledge of the particular trade route to be served. Matters relating to the building of new tonnage, and the repair of existing tonnage, and operation at sea will be dealt with by the managements of the individual companies. No decision has yet been reached with regard to the directorate of the holding or other companies, but it is understood that Mr. Walter Runciman, in view of his acceptance of the office of President of the Board of Trade, has resigned his position as a voting trustee. Several rumours have been recently current with regard to the acquisition of the White Star Line and the Coast Lines by other interests, but so far nothing definite has been said about these changes.

The Wages of Metal Workers in Berlin.

An interesting and important decision has been made by the arbitrator who was appointed to consider the claims of the employers in the Berlin metal industry to reduce wages in the trades affected. The arbitrator has refused the employers' claim for a wage reduction, and has prolonged the existing wages agreement. The decision above recorded supports a view which is widely held in Germany that it would be both imprudent and inhuman to attempt to depress further the standard of living, without any certainty that prices of commodities will fall in a corresponding manner. The decision of the arbitrator has now called a sudden halt in the wage reductions which have been going on in Germany during the last few months. The question of bringing about a fall in retail prices, commensurate with the lowering of wages and world prices, has recently received the attention of the German Cabinet, and a special sub-committee of the Economic Advisory Council has been entrusted with the task of devising if possible measures which will, if enforced, bring about a reduction in the prices of those commodities which directly bear on the cost of living.

Reduction in Suez Canal Dues.

At a meeting of the Suez Canal Company, which was held in Paris on Monday last, the directors decided to reduce the Canal transit dues by 10 per cent. This decision will be warmly welcomed by those British and foreign shipping lines which make use of the Canal, more especially as since the suspension of the gold standard by Great Britain the Suez Canal Company has required all dues paid in pounds sterling to be tendered at their real value in gold francs, thereby adding an increase in expenditure to the British shipowner. For some time past the Liverpool Steam Ship Owners' Association has taken up energetically the question of the high transit dues for the Suez Canal, and it has pointed out that the decrease in traffic through the Canal cannot wholly be attributed to the depression in the shipping trade, but to some extent is due to the diversion of ships in order to avoid the Canal dues. Bearing on this, it may be stated that the number of transits through the Canal from January 1st to October 20th were 4352, compared with 4688 in 1930, while the receipts were 761,920,000f., compared with 842,360,000f. We understand that Mr. Richard D. Holt, the senior partner of Alfred Holt and Co., recently met the chairman of the Suez Canal Company in Paris, when various aspects of the position were discussed in a cordial manner. The Suez Canal Company has further decided, we learn, to pay salaries and wages in gold instead of Egyptian paper currency, which will mean a gain to the employees of about 30 per cent. It is also announced, however, that there will be a 5 per cent. reduction in wages, which will take place from December 1st.

Flowing Water.

By J. M. LACEY.

No. V.—IRRIGATION.*

Part II.

Typical Canals.

In the two provinces of Piedmont and Lombardy, the richest in Italy, irrigation has been practised from almost the earliest period of which any authentic record remains and has advanced progressively to the present time. The surface of the land forms a great plain, which Nature seems to have disposed in the manner most favourable for irrigation. It slopes regularly at a gentle angle from the foot of the Alps to the river Po, which forms a great natural drainage channel and is intersected by numerous streams and rivers from which an abundance of water can be drawn. In Piedmont the canals are designed solely for irrigation, whereas in Lombardy they were originally constructed equally for navigation and irrigation. In consequence of the development of railways the navigation has fallen off. The climate of both countries is eminently suitable for irrigation, the mean temperature being 70 deg., with a minimum of 40 deg., and with an average rainfall of 37in. to 38in. The conditions obtaining comply with the old French cultivator's formula, viz., "Water+heat+manure =vegetation. If any one of these factors disappears the result is zero."

The Cavour Canal in Piedmont takes its source from the Po; the river at the canal head is 500 yards broad and runs between high banks on a hard stony bed, partaking much of the nature of a torrent. The canal at its head carries a volume of 3885 cusecs; it has a uniform fall of $^1/_{4000}$ for the greater part of its length, except in its fifth or last reach where the fall is reduced to $^1/_{5000}$. The length of the canal is 24½ miles, its bed width in its head reach is 65·6ft., and its depth of flow 11·15ft. The depth and width diminish in each reach, and in the fifth or last reach the volume of flow is 1059 cusecs with a bed width of 24·6ft. and a depth of flow of 9·84ft. The line of the canal is admirably chosen, being across a great plain which slopes gently and regularly to the river Po, so that the water from the canal is conducted naturally to the ground which it irrigates. The supply from the Po was found insufficient, and the canal receives an additional supply from the Dora-Baltea. The canal is designed for irrigation alone.

In Lombardy the Naviglio Grande Canal bears traces of its early origin by its tortuous course, in order to overcome inequalities of the ground, the use of masonry falls for reducing slopes being unknown to our ancestors. The head of the canal is on the left bank of the river Ticino; the main canal is 31 miles long, and it has a mean slope of 3·05ft. per mile, being irregularly excavated, the depth, width, and slope varying. The great slope renders navigation against the current a matter of impossibility except for empty boats. The waters of the Ticino are clear and the river appears to carry little silt, but a certain amount is deposited, and the canal is closed yearly in March just before the cultivation season for repairs and clearing. The maximum supply is 1850 cusecs, the bed width varies from 160ft. to 70ft., and the depth from 15ft. to 4½ft. Motive power is supplied to over 200 mills. The canal of the Ticino right bank for irrigation alone has an inclination of $^1/_{1388}$.

The canal of Pavia in Lombardy is constructed for both irrigation and navigation. The first line of navigation between Milan and Pavia dates from the fourteenth century. The decree ordering the construction of the present canal was signed by Napoleon I. on June 20th, 1805. The canal is 20 miles long, having its head in the Naviglio Interno at Milan and tailing into the Po at Pavia. The total fall is 184ft., of which 170ft. is absorbed by twelve locks, giving the canal a bed slope of 0·82ft. per mile—$^1/_{6440}$. The width of the canal at water surface is 35ft., the depth of water 5½ft. at its head, and the volume of water passing down the canal is 300 cusecs in winter and 213 cusecs in summer.

The Marseilles Canal in France, taking off the river Durance, was constructed during the Revolution for the supply of water to Marseilles and for irrigation. It carries at its head a volume of 424 cusecs, with an inclination of $^2/_{1000}$. Its section is trapezoidal, with a bed width of 9·84ft., width at water surface 30·84ft., and depth of water 7·87ft. A considerable portion of the sides is lined with masonry.

The inclination which appears to be most adapted to the waters of La Provence, containing much matter in suspension, ranges between $^6/_{10000}$ and $^9/_{10000}$.

In India the river Kistna, in its deltaic region, like the majority of deltaic rivers, runs on the crest of an elevated ridge formed by its own deposits during a long series of years, the country falling off gently from the river towards the right and left, and having at the same time a steady general inclination towards the sea coast. In its course through the delta, a distance of some 60 miles, the river bed has an average fall of 12in. a mile. The average fall of the delta to the right and left of the river is 18in. a mile. In the case of the river Godavery, where it debouches into the plains after passing through the gorge at Palanaram, the average fall of the river in its southerly course to the sea, a distance of some 60 miles in a direct line, is 6in. a mile; the high flood surface level has a fall of 15in. to 18in. a mile. The same characteristic features of deltaic rivers obtain in the case of the Godavery; below Dowleshwaram, the head of the true delta, towards the east and west the transverse slope is 3ft. per mile on the east and 8ft. per mile on the west towards the Collari Lake. Hence the river runs on the crest of a great natural embankment, ranging from a minimum of 6ft. to a maximum of 16ft. in height above the level of the country two miles distant from each bank. It is obvious that the two deltas are eminently suited for irrigation. The Godavery delta system comprises some 700,000 acres, and the Kistna delta system 672,000 acres of rice land; the capital outlay per acre irrigated being Rs. 20 per acre in the case of the Godavery, and Rs. 24 per acre in the case of the Kistna delta system. The systems yield a net return of 17 to 18 per cent. on the capital outlay. The canals of both systems are designed for both irrigation and navigation, and there is a considerable amount of boat traffic in both the systems. The velocity is limited to 2ft. per second. The main conductor canal of the Godavery Western Delta has a fall of $^1/_{15000}$. Numerous locks are provided to overcome the slope of the country.

The Periyar Northern Main Canal in the district of Madura, South India, runs along the foot of the Simmallay Hills, the soil traversed is gravelly, overlying the decomposed granite rock which forms the base rock of Southern India. The inclination or slope of the canal bed is 1·24ft. per mile, the full supply depth is 6ft., the bed width being reduced at each off-take. The branch channels which distribute the water over the 120,000 acres of rice land are aligned on the minor ridges and have a general fall of 6ft. per mile.

In the Cauvery Reservoir Project irrigation system, in the Tanjore district of South India, the country traversed is similar in character to that described above, and the distributaries run on alignments over ground having a considerable fall, the average being 8ft. a mile.

When the Ganges Canal was first constructed the slope, some 2ft. per mile, was found excessive and caused considerable erosion. This effect has been remedied by a series of drops, or cascades. It was found that the Agra Canal, constructed after the experience gained in the Gangese, with a gradient of $^1/_{10000}$, gave very satisfactory results (*vide* The Engineer, July 3rd, 1931, "Flowing Water," IV.). The valleys of the Punjab Rivers have slopes averaging $^1/_{5280}$, and the inclination of the main canals in that Province for irrigation alone are from $^1/_{6666}$ to $^1/_{6250}$ (*vide* "Flowing Water," IV., The Engineer, July 3rd, 1931).

In Egypt, in the case of the Nile, with a fall of nearly 6in. a mile, by taking a supply from a point higher up the river than the land to be irrigated, and as some inclination must be given to enable the water to flow, a fall of 3in. a mile, or $^1/_{20000}$ gains 3in. on the river in a mile. Thus land can be irrigated that is somewhat higher in level than could be commanded by the river directly opposite it, by a canal taking off many miles upstream of the area to be irrigated, and only deep enough to catch a supply from the river in flood, or when the level is raised artificially by barrages.

Distributaries.

In the case of minor distributaries, or irrigation feeders, their object is to distribute the water over the ground, and their dimensions must be regulated by a number of circumstances arising either from the general inclination of this ground or from the nature of the soil. Stated in general terms, the problem to be solved is, given the quantity of water to be supplied, and the rate of inclination which will generally correspond with the general slope of the country, to design the section. In arranging the dimensions of the feeder there are numerous causes in operation by which the effective quantity of water distributed over the land is diminished. Amongst the principal may be cited the loss arising from evaporation and percolation, and that arising from the defective state of the sluices and other works.

Dimensions.

In designing an irrigation system, an attempt should be made to secure a uniform velocity for the main canal and all its branches. The minimum velocity required to prevent the deposit of alluvial matter in suspension, or the growth of aquatic plants, is said to be 1½ft. per second. The maximum permissible velocity depends, as already stated, on the character of the soil and other circumstances. The surface slope of the water in the canals should correspond with the inclination or slope of their beds. As regards the depth of excavation, the most favourable conditions occur obviously when the canal water is partly within and partly above soil, so that the earth excavated from the canal or channel is sufficient for the banks. For sanitary reasons it may be desirable to keep the water as a general rule within soil, but the effect of this will be greatly to increase the cost of excavation; and if, as often is the case, a sandy stratum underlies the superficial clay, it is very undesirable to dig deep. Fig. 1 indicates the economic depth of excavation for the Periyar Northern Main Canal, Fifth Reach. The hydraulic details are: Bed width, 51ft.; side slopes, 1½ to 1 cutting and 2 to 1 embankment; full supply depth, 6ft.; bed fall, 1·24ft. per mile. The minimum conditions to be fulfilled were: height of bank above bed level, 12ft.; top width of banks, 6ft.

The proportion of depth to bed width depends on the nature of the soil traversed by the canal, and the relation between the two dimensions is best observed in natural streams and rivers flowing in the area in which the canal system is to be excavated. In the Western Jumna Canal the ratio is as 1 : 13, being that which the stream has in course of years formed for itself. In the Bari-Doab Canal the ratio is as 1 : 15; in the Sutlege Canal as 1 : 14. In the Soane Canal the ratio of bed width to depth is given by the formula:

$$B=(D+1)^2.$$

In the Sirhind Canal the ratio of depth to bed width is 1 : 15.

These figures are for conditions obtaining in the Panjah, where the soil is of a light texture. In other Indian canals the relations of depth and bed width are:—Nira Canal: Bed width, 23ft.; depth, 7·5ft. Betwa Canal: Bed width, 15ft.; depth, 5ft. For the distributaries of the Cauvery Reservoir project, S. India, the following rules were laid down. Ratio of depth and bed width:—

For channels discharging	10	cusecs	.. ..	As	1 : 3·5
,, ,, ,,	25	,,	.. ..	,,	1 : 4
,, ,, ,,	100	,,	.. ..	,,	1 : 4·5
,, ,, ,,	200	,,	.. ..	,,	1 : 5

These proportions were liable to modification according to the peculiar circumstances of each case.

In the case of irrigation distributaries in Italy, the minimum depth of the channel is fixed at 3ft., and the mean width of the channel at 1½ times the depth. The following figures have been laid down in America for the relation between the dimensions of water surface and depth:—

Width of water surface. Feet.	Depth of Canal. Feet.
6	1·5
10	1·6
20	2·5
40	3·3
100	6·7
200	9
300	11

(*Engineering News*, Vol. 60, No. 11, September 10th, 1908).

In the Sanjoaquin Canal, with a bed width of 28ft., the depth is 4ft.; with slope of cutting, 2 : 1, the water surface will be 44ft. in width.

In cases where a river brings down large volumes of sand, which is either rolled or swept along its bed, as is the case with most of the rivers of India, provision has to be made in the design of the canals deriving their supply from such rivers, where the sand is carried into the canals and deposited in the head reaches, either by widening the canals in their head reaches to allow for the reduction in their designed depth, or by designing the canal or channels with such a constant gradient or inclination as would cause a velocity, whatever the depth of water in the channel might be, as would sweep the sand through the canal system on to the fields—*vide* "Flowing Water," No. IV., The Engineer, July 3rd, 1931.

Conditions may, however, arise where no sand is carried into the canal system, and the channels either erode or accrete in the soil which they traverse, the inflowing water being either turbid or else clear,

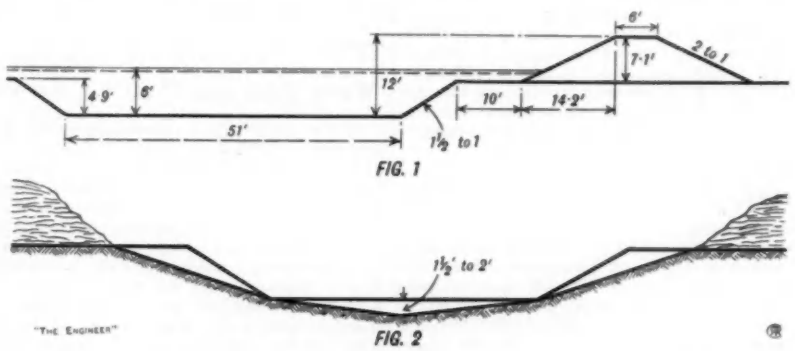

FIG. 1

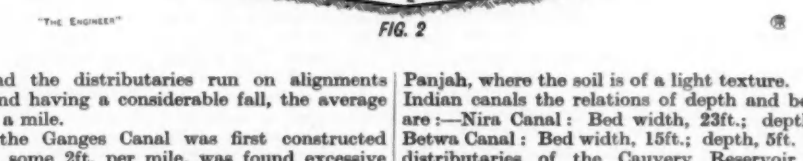

FIG. 2

* No. V., Part I., appeared November 6th.

according to the season of the year. The problem that arises is to design such a channel that erodes or accretes in its own soil with a velocity so equitable that it neither scours nor deposits alluvial matter on its bed or slopes. Such a channel is termed a regime channel.

The problem to be solved is, given the quantity of water to be supplied, to determine the section. The gradient or slope of the canal will depend on the general inclination of the country traversed by the canal system. But as the leading canal, or the conductor, will in most systems be carried on a contour until it reaches a point in the area to be irrigated from which it will run on the ridge of the country, it will be possible to fix the gradient within certain limits. Also when the canal or channel traverses the ridge of the country, unless the fall of the country be small, the slope of bed or inclination of the channel may be designed to be less than that of the country, the difference being overcome by a series of drops or falls. As a guide, it is desirable to ascertain from the data given the theoretical slope which will ensure a regime channel, and to compare the slope so obtained with the general inclination of the country to be irrigated.

Since in similar figures the wetted perimeter of a channel varies as the linear dimension d, the depth of the channel; and the area of the wetted section as d^2 if A_o and R_o be the area and hydraulic mean radius of the channel when d is unity, for any other size of similar section the area will be $A_o d^2$, and the hydraulic mean radius $R_o d$.

In Manning's formula

$$b=\frac{1\cdot486}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

If Q be the required supply in cusecs

$$\frac{Q}{A_o d^2}=\frac{1\cdot486}{n}(R_o d)^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$\therefore\ d=\left(\frac{1}{A_o R_o^{\frac{2}{3}}}\right)^{\frac{3}{8}}\times\left(\frac{n Q}{1\cdot486}\right)^{\frac{3}{8}}\times\frac{1}{S^{\frac{3}{16}}}$$

$$d=K\times\left(\frac{n Q}{1\cdot486}\right)^{\frac{3}{8}}\times\frac{1}{S^{\frac{3}{16}}}$$

If m be the relation of bed width to depth in a trapezoidal section and the side slopes are as $\frac{1}{2}$ to 1, when $d=1$

$$A_o=m+0\cdot5 \text{ and } R_o=\frac{m+0\cdot5}{m+2\cdot236}$$

—*vide* "The Irrigation Pocket Book" (Buckley).

$$\therefore\ K=\left\{\frac{(m+2\cdot236)^{\frac{1}{2}}}{(m+0\cdot5)^{\frac{1}{2}}}\right\}^{\frac{3}{8}}$$

$$\log K=\tfrac{1}{2}\log(m+2\cdot236)-\tfrac{1}{2}\log(m+0\cdot5)$$

Table I. gives values of K for various values of m.

Assuming therefore a relation of bed width to depth from observation or experience, the channel can be designed for the volume to be carried and for the slope adopted.

TABLE I.

m.	K.	m.	K.	m.	K.
1	1·04	10	0·430	30	0·281
1·236	0·967	15	0·367	35	0·265
1·5	0·90	20	0·329	40	0·234
5	0·565	25	0·302	50	0·232

For any section the hydraulic mean radius is a maximum when $m=1\cdot236$.

Should it be desired that the velocity be constant—

$$\text{Since } \frac{Q}{A_o d^2}=v$$

For any desired velocity v—

$$v=\frac{1\cdot486}{n}(R_o d)^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$\therefore\ (R_o d)^{\frac{2}{3}}=\frac{v n}{1\cdot486}\times\frac{1}{S^{\frac{1}{2}}}$$

Diagram Fig. 3 shows the relation between $\frac{1}{S^{\frac{1}{2}}}$ and $(R_o d)$ for velocities of 2ft., 3ft., 4ft., and 5ft. per second, n being taken as $=0\cdot0225$.

Table II. gives values of R_o for various values of m, whence the value of d can be obtained and the channel designed.

TABLE II.

m.	R_o.	m.	R_o.	m.	R_o.
1	0·436	5	0·76	35	0·955
1·236	0·5	10	0·858	40	0·958
1·5	0·535	15	0·9	45	0·963
2	0·59	20	0·922	50	0·967
3	0·668	25	0·93		
4	0·722	30	0·946		

The question of inclination, or slope, of a channel bed so as to obtain regime conditions is a problem not easily solved; the volume of water carried, the dimensions of the watercourse, the nature of the soil traversed are all factors which influence the solution. In an article, "A New Hydraulic Formula"—THE ENGINEER, June 17th, 1927—the following rule is obtained:—

$$\sigma=\frac{1}{\log(Q^2)} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Where Q is the volume to be carried in cusecs and σ is the fall in 1000ft. It is obvious that this rule cannot be applied to those countries where the fall of the river is small, as in the case of the Nile. In the "Proceedings" of the Institution of Civil Engineers,

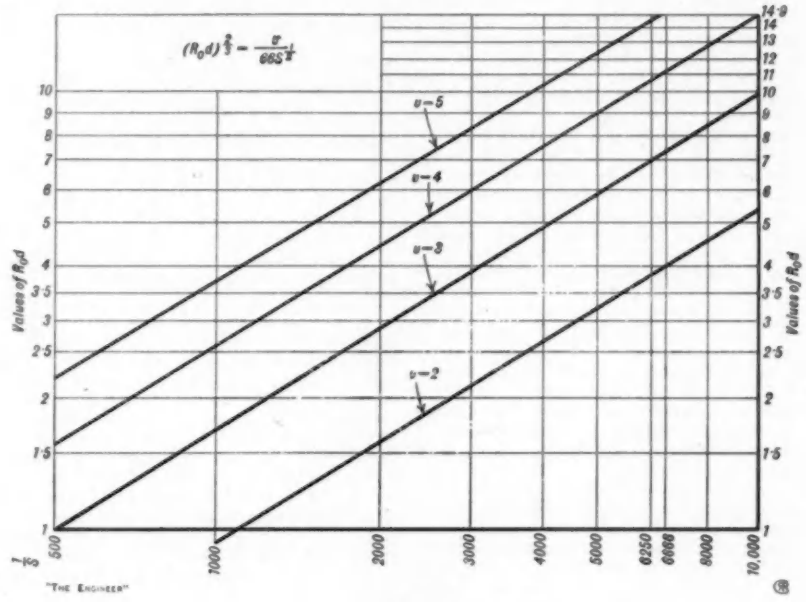

FIG. 3

Vol. 229, "Stable Channels in Alluvium," the slope for regime conditions is given as

$$S=f^{\frac{5}{2}}\div1788\,Q^{\frac{1}{2}} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Where Q and S denote the volume of flow and the inclination, and f is a factor depending on the nature of the soil traversed and related to n, Kutter's coefficient for rugosity by the equation

$$n=0\cdot0225\,f^{0\cdot25}$$

Table III. compares the slopes obtained from the two formulæ. In the case of the latter the value of n

TABLE III.

Q discharge in cusecs.	Formula (1). σ slope per 1000.	Formula (1). S slope in unity.	Formula (2). S. slope in unity. $n=0\cdot02$, $f=0\cdot6$.	Formula (2). S. slope in unity. $n=0\cdot0225$, $f=1$.	Formula (2). S. slope in unity. $n=0\cdot025$, $f=1\cdot5$.
5	0·715	1/1,400	1/ 5,470	1/2,338	1/1,190
10	0·5	1/2,000	1/ 6,150	1/2,624	1/1,330
20	0·384	1/2,600	1/ 6,900	1/2,945	1/1,500
40	0·312	1/3,200	1/ 7,730	1/3,300	1/1,680
100	0·25	1/4,000	1/ 9,000	1/3,852	1/1,960
150	0·23	1/4,350	1/ 9,650	1/4,122	1/2,100
200	0·217	1/4,650	1/10,000	1/4,324	1/2,200
500	0·185	1/5,400	1/11,800	1/5,037	1/2,550
1,000	0·167	1/6,000	1/13,200	1/5,654	1/2,870
2,118	0·15	1/6,666	1/15,000	1/6,400	1/3,250
10,000	0·125	1/8,000	1/19,400	1/8,278	1/4,200
20,000	0·116	1/8,600	1/21,800	1/9,315	1/4,740
1,700*	0·1548	1/6,461	1/14,440	1/6,177	1/3,143

* *Vide* Chan. No. 1, Appendix A, "Proc.," Inst. C.E., Vol. 229, page 286.

is taken as $n=0\cdot02$ for channels in good order; $n=0\cdot0225$ for channels in fair order; and $n=0\cdot025$ for channels in bad order.

Sir John Benton states that in the Punjab good and fair channels occur with equal frequency. A well-maintained channel for $n=0\cdot02$ in the cold weather, when there are no sand ripples, would give $n=0\cdot225$ later when the water became turbid, and a good deal of rolled sand was carried along the bed—"Proceedings," Institution of Civil Engineers, Vol. CCI., pages 71 and 72.

Formula (1), as stated above, will not apply to countries such as the basin of the Nile, where the slope of the river is small. Also the formula gives slopes less than those adopted in European irrigation systems, and in the irrigation canals in the uplands of Southern India. The formula applies apparently to conditions characteristic of a particular area. By the introduction of the factor f in formula (2), it becomes applicable to a variety of conditions. The difficulty will arise in deciding on the particular value to be ascribed to the factor f or its relative "Kutter n."

In the "Proceedings" of the Institution of Civil Engineers quoted above, second volume, 229—"Stable Channels in Alluvium"—page 273, it is stated that for a given discharge the wetted perimeter of a stable channel is constant, and independent of the fineness of the silt transported, the silt merely controlling the shape, which in the case of trapezoidal sections would indicate the ratio of bed width to depth.

The relation between wetted perimeter and volume of flow is given by the equation

$$P_w=2\cdot668\,Q^{\frac{1}{2}}$$

Where Q is the volume of flow in cusecs, and P_w the wetted perimeter in feet. Should further observation prove this formula to be generally true, it gives an additional factor to be used in the design of regime channels, as above described. It is obvious that

$$P_w=d\,(m+2\cdot236)$$

for trapezoidal sections having side slopes of $\frac{1}{2}$ to 1.

In the "Proceedings" of the Institution of Civil Engineers quoted above it is also stated that a natural channel transporting and flowing in its own silt under stable conditions has a tendency to assume a semi-elliptical section—page 272. This fact is possibly true in the case of channels flowing in light soils capable of erosion. In the light soils of the San Luis Valley in Colorado and in certain valleys in California it is stated that experience has shown that the "sub-grade" produces a form approaching an ellipse. This cross section tends to keep the current in the centre of the channel and to keep up its flow with the least exposure to friction and seepage when the volume in the canal is low. The "sub-grade" is given by designing the canal as a trapezoid, with berms, and sloping off by removing the berms and by continuing the slope from the bottom of the canal towards the centre to a depth or sub-grade of 1ft. to 2ft. below the original bed level as in Fig. 2.

Mechanical Aspects of Electricity.*

By LLEWELYN B. ATKINSON, F.K.C., Past-president of the Institution of Electrical Engineers.

FARADAY, whose electro-magnetic discoveries we are celebrating this year, had the conviction that all the "forces of Nature" as he called them—by which he meant heat, light, electricity, and magnetism—were inter-related and as early as 1821 he entered in his notebook "Convert magnetism into electricity." The volumes of his researches record the experiments he made to that end, but it was only in 1831 that he achieved it in his first great experiment of two coils wound on a ring of iron. In 1873 Maxwell published his "Treatise on Electricity and Magnetism." This work was stated by the author to be the theoretical development of Faraday's discoveries, adopting and developing Faraday's great idea that the seat of electrical action is in whatever fills the space between electrified or magnetic bodies, which he referred to as the ether, rather than in the bodies themselves. Maxwell showed how by certain definite stresses and strains in the case of electrostatic effects, and certain rotational properties in the case of electro-magnetic effects, the observed phenomena could be given a mechanical basis. The theory, moreover, led to the prediction of certain connections between optical properties of transparent matter and electrical forces, and finally led Maxwell to the proposition that radiant heat and light are themselves electro-magnetic phenomena; being in fact electro-magnetic oscillations of an all-pervading elastic medium called the ether, and propagated in space with the velocity of light.

Maxwell, in describing in this treatise Faraday's experiments in electrolysis, was led very near to the idea of an atom of electricity. In 1874 Johnstone Stoney, in an address to the British Association, referred to "the atoms of Electricity" as one of the fundamental physical units of Nature, and gave an approximate calculation of its value. In 1888 Hertz demonstrated the transmission of electro-magnetic actions in space, and showed that it took time, that is, was not instantaneous, thus experimentally proving Maxwell's theory. In 1880 H. A. Lorentz had proposed a theory to explain the action of matter on light, postulating the presence of minute electrically charged particles revolving round the atom, and J. J. Thomson, in 1896, having experimentally determined the ratio of the electrical charge to the mass of the particles in Crooke's radiant matter, found it corresponded with the requirements of Lorentz's theory. So gradually the particulate nature of electricity was being established.

* Institution of Mechanical Engineers, the eighteenth Thomas Hawksley Lecture.—Abridged.

The Modern View of Electricity.—Electricity consists of separate or individual entities which we call electrons; electrons are the entities of which matter is largely composed; the atoms of matter are built up of a nucleus, which itself is made up of hydrogen with or without associated electrons, together with other electrons assumed on this theory to revolve in a planetary manner round the nucleus. The detachment and movement of electrons give rise to electric actions; the change from one orbit to another gives rise to radiation phenomena. Electrostatic actions arise when one of the outer electrons of an atom is removed from the atom; electric currents and electromagnetic actions arise when the outer electrons of atoms are caused to move, in a common direction, relative to the nucleus, this being either a limited movement as in a dielectric or insulator, or a movement from one atom to another as in a conductor. This movement is set up either mechanically or by chemical attraction or by the changes of motion of neighbouring electrons.

In the older method of treating electrical phenomena the subject was divided into electrostatics and electro-dynamics. To-day we think in terms of electrons. Electrons, which constitute what in the older theory was called negative electricity, separated from the atoms to which they belong, and the positive ions, that is, atoms which have lost an electron and have a positive charge, give rise to the phenomena classed as electrostatics. Electrons in motion give rise to the phenomena of electro-dynamics.

But there are relations of electrons to matter which are inertial not electric. If a current of electrons is started in a wire, magnetic energy is developed, and this requires energy from outside supplied from a source of electromotive force to develop it. But there is another way of producing a motion of electrons relatively to the ionised atoms in a wire. If a coil of wire is rapidly spun on its axis and then suddenly stopped the electrons which do not move in the copper wire do not stop at the same instant as the positive ions, and the relative motion is an electric current. This experiment was realised by Tolman and Stewart about 1916. Again, if a coil freely suspended has a current started in it by an electromotive force, the electrons are accelerated, but the positive ions are accelerated in the opposite direction, and the coil consequently rotates on its axis. This experiment was realised by Professor Barnett and only recently described. Both these experiments confirm that the current is composed of negative electricity having the property of inertia.

Electrons at Rest; the Nature of the Electric Action and the Mechanical Energy Involved.—The method of regarding electrical repulsion and attraction simply as a property of electricity exercised at a distance was adopted by the early electrical investigators, and lent itself to exact mathematical calculation of the actions arising, but from the moment that Faraday rediscovered the fact, originally discovered by Cavendish, that the attractions and repulsions depended on the *kind* of matter between the electrified bodies, attention had to be given to the intervening space. Faraday finally regarded electrification merely as something which put the intervening material or ether into a state of strain, and he showed that the strain could be represented as caused by stress equivalent to a tension along certain lines joining the negatively and positively electrified conductors, combined with a pressure at right angles to these lines. Faraday called the directional lines lines of force, and he regarded them as physically existing. Maxwell adopted this view of the importance of the space action and developed its consequences mathematically, and when in accordance with these ideas we speak of attractions and repulsions in the electric field we are viewing the attractions as due to a tension along a line or lines between an electron and a positive ion, the repulsion as due to pressures at right angles to these lines of tension.

No practical use is made of the mechanical forces exerted by electrons at rest for purposes of motive power, because with apparatus of any reasonable size the work done is small, but a limited use has been made in the past of the inverse action for gas lighters and for Röntgen ray apparatus. In these mechanical work is expended to separate electrons and positive ions, so as to allow them eventually to recombine and cause a spark, when the electrons accelerated under the mechanical forces strike the ionised atoms and set up the short electro-magnetic oscillation which we call X-rays.

Electrons in Motion: The Electro-magnetic Field.—We may now turn our attention to the electrical actions of electrons in motion. The force of attraction due to the motion between two electrons moving parallel to one another and with velocities V_1, V_2 at the moment they are 1 cm. apart is such that $F = V_1 \times V_2 \times 1 \cdot 3 \times 10^{-28}$ dynes. This force is called a magnetic force and the velocities, as previously mentioned, are to be taken as measured relatively to the surrounding matter. Measurement of the magnetic forces exerted by single moving electrons is quite impossible, but measurements made by Rowland, using a rotating wheel with insulated charged sectors—that is, sectors charged with electrons—and utilising the magnetic force thereby set up to deflect a magnet, have proved the existence of this magnetic force. But the practical way of moving electrons in quantity so as to produce mechanical—magnetic—forces easily measurable, is to set up in a conducting wire that movement of electrons which we call an electric current.

A current of 1 ampère—that is, 1 coulomb of electricity per second—is equivalent to the passage of $0 \cdot 63 \times 10^{-19}$ electrons per second at any point in the conductor, and this number is equivalent to the product of the number of electrons in a unit of volume which are moving, multiplied by their velocity. The doubtful point is as to the number concerned in the movement. Is it all the planetary electrons, or part of them, and, if the latter, what part? In a copper conductor, if all the twenty-nine planetary electrons take part, then a current of 1 ampère in a wire of 1 square millimetre would give an average electron velocity—assuming $8 \cdot 52 \times 10^{-22}$ atoms in a cubic centimetre—of $2 \cdot 5 \times 10^{-4}$ cm. per second, or not quite 1 cm. per hour. If only one outer planetary electron takes part, then about 26 cm. per hour will be the average velocity.

Ampère, who discovered the mechanical forces between electrical circuits and who stated the laws of such forces, was a mathematician, and viewed such forces as being due to the summation of the actions of indefinitely small parts of one circuit upon every indefinitely small part of another circuit, this action being reciprocal and the forces being inversely as the square of the distance. The statement of this idea in the laws of Ampère led to correct results, and they are, in fact, a statement of the action of the individual moving electrons upon one another. In fact, the mechanical force and its direction are the same whichever way they are expressed, and the configuration of Faraday's lines of force can be calculated point by point by the older method. But the idea of a physical field has been very fruitful and the lines of force give a mental picture which is very useful. We must, however, clearly appreciate that it is a mental picture only; no lines exist, they are signposts only, indicating the properties of the space in which they are drawn. Using the conception, we may say that every electric conductor conveying a current is surrounded by lines of magnetic force, so also is a dielectric during the time that electric charges on its surfaces are varying, this variation being equivalent to a passage of electrons and therefore a current.

We must note a difference between the electric field and the electro-magnetic field. In the electric field the lines of force start on an electron and end on an atom which has a positive charge. In the electro-magnetic field the lines are closed curves. There are no ends, and these curves surround the moving electrons so that the moving electrons are in the centre of the closed curve, which are in planes at right angles to the direction of motion.

The Faraday-Maxwell conception, when applied to circuits carrying electric currents, leads to results which allow all the mutual actions of electric currents to be correlated. So that in the conception which they realised, not only the mechanical forces in a steady stage, but the electrical condition arising under states of change due either to mechanical and electrical motions, are included.

By means of such a conception we have the fundamental idea that an electric circuit and a magnetic circuit are inseparably united. We must no longer think of an electric current producing an electric field, for electric current and a magnetic field are one and the same thing. The electro-mechanical forces in such a system are such as would arise if the line of magnetic force tended to shorten—tension—and at the same time exerted a pressure at right angles to itself against any other similar line of force.

The Electro-mechanical Actions of a Single Electric Circuit.—Let us consider a single interlinked electric and magnetic circuit. In order to set up an electric current in the electric circuit we must apply an electromotive force. We are accustomed to the idea that to keep a current going we must continue the electromotive force. This arises because the conductor offers what we call resistance—equivalent to a sort of friction—but conductors at a very low temperature have practically no resistance, and it simplifies ideas in considering the mechanical actions to assume there is no resistance. The same results arise if we consider the actions to take place in an exceedingly short time, as then the resistance has not time to absorb the energy. Applying an electromotive force to the circuit, the current gradually rises. In theory there is no limit to its rise, what is happening is that the electromotive force is accelerating the electron stream, with its accompanying electro-magnetic field, in which the energy is stored.

The energy put in may be measured in two or three ways. It may be stated in terms of the external work done to produce it, that is one-half the product, at each moment of the electromotive force and the current; or as the product of the magnetising force of the coil and the total magnetic field produced; or, again, by utilising a quantity called the coefficient of self-induction, which takes into account the magnetising force and the relation of that force to the geometrical form of the electrical circuit and the material in which the magnetic field is produced, in which case the energy is expressed as one-half the square of the current multipled by the coefficient of self-induction.

A property of such a linked electric field and magnetic circuit is that, once set up by an electromotive force, the strength of the field does not change, and so the current changes if by moving the coil we vary the magnetic properties of the material in which the field is created. The product of current and magnetic field strength—that is, the energy—thus changing enables mechanical work to be done by the stored energy.

The Electro-mechanical Actions of Two Circuits.—Let us consider the case of the mutual action of two electric and magnetic currents upon one another. Taking as before the case of circuits of no electrical resistance, to establish a current in either circuit considered separately requires an electromotive force, and the law holds good that the magnetic field passing through any circuit will remain constant unless an electromotive force is applied.

Consider two electric circuits A and B. If currents are started in one or the other, each would have an amount of energy relative to its own current and coefficient of self-induction, but, in addition, there is an amount of energy which is proportional to the products of the currents in the two circuits multiplied by a coefficient called the coefficient of mutual induction, which depends upon the material and form and relative position of the two circuits. The work done by the relative motion of two coils in a configuration whose magnetic properties is the same for all positions of the coils depends only on the changes of the coefficient of mutual induction.

Next consider the case of two electric circuits at right angles to one another, in one of which A, a current and magnetic field are established, and in the other B there is no current or magnetic field. Now move B to a position B_1. Part of the flux through A would pass through B, so a current is set up in B which is just sufficient to produce an equal and opposite magnetic field through B; and since the magnetic path for the field of A is now more constricted, the currents in A become larger, so as to maintain constant the flux through it. These results constitute Faraday's electro-magnetic induction, and the arrangement forms, in fact, an elementary electric generator. Since the current in circuit A is increased and the electro-magnetic flux through it the same, the energy related to A is greater, and since there is a magnetic field through B, due to its own current, the energy of the system is increased, and mechanical work has been expended in the motion. As the currents are in opposite directions, the coils will repel one another. If we allow them to rotate, they will move until the current in B is again zero, and the current in A has returned to its original value, and mechanical work will have been done. This is an elementary motor. It is particularly to be noticed that the current changes in both the coils.

Since a line of magnetic induction has no ends, the number of lines which enter or leave the enclosed area of a coil can only be altered by these lines cutting the coil, and so it is convenient to picture the action in these cases and to make calculations with reference to the rate at which lines of force are added to or subtracted from the area enclosed by the coil, or, alternatively, by the length of wire moving normal to a magnetic field multiplied by the density of the field and by the velocity, the product of these three being in fact the total number cut per second.

Practical Application of the Mechanical Action of Electric Currents.—We see that there are two quite separate methods by which mechanical forces are exerted, and mechanical work done by electric circuits: —(*a*) By changing the material of the magnetic circuit of a single electric circuit, and (*b*) by changing the relative position of two electric circuits having mutual magnetic circuits. It will be seen later that these cases are very closely related.

The Law of Electro-magnetic Induction.—I have spoken of the electric actions—that is, electromotive force—arising when the total flux through a coil is varied, and used language following that of Maxwell, who stated the law thus:—"If a conducting circuit embraces a number of lines of magnetic force, and if from any cause whatever the number of these lines is diminished, an electromotive force will act round the circuit, the total amount of which will be equal to the decrement of the number of lines of magnetic force in unit time."

Faraday always spoke of cutting the lines of force by the conductor as the essential action. Is there any difference? In other words, in a closed electric circuit is the action—electromotive force—something general, distributed through the circuit and due to the change in flux through the circuit, or does it arise where actually there is a crossing of the field by the conductor? There seems no doubt that Faraday's view is correct.

The Magnitude of the Electro-mechanical Forces.—The magnitude of the mechanical forces set up by electric circuits and their magnetic fields may be considered. The unit of electric current in absolute electro-magnetic units is defined as that current which —in air—for each centimetre of length forming an arc of circle of radius 1 cm. produces a force on a unit magnetic pole at its centre of 1 dyne.

This is not really a realisable measurement, because we must deal with complete circuits. The attraction between two circular wires carrying equal currents of I ampères is $F = \frac{4 n r I^2 \times 10^{-2}}{d}$, where r is the radius of the circuits and d their distance apart in centi-

metres. Taking a pair of circuits 10 cm. radius, 1 cm. apart, and the currents 10 ampères, the attraction becomes F=125 dynes, or about one-seventh of a gramme weight.

This force seems small, and is so in the case of small currents, but rising as it does as the square of the current it becomes very large in the case of heavy currents, such as arise from short circuits on large generators. Thus, if in the case above the currents were 10,000 ampères, the force would be about 12,000 kilos., say, 12 tons. Thus, the coils of transformers have tremendous forces, running into tons, exerted between them in these circumstances, as also do the coils of reactors—that is, coils placed in the circuits of large generators to limit the current on short circuit. At the same time, there is a radial force on every such coil tending to enlarge the circumference. In the case of the coils used, about 6in. diameter, by Dr. Kapizka to develop field strengths up to 300,000 units—gauss—for studying the effects of strong magnetic fields, the pressure inside the coils, which have an internal diameter of about ¼in., tending to burst them is equivalent to a hydrostatic pressure of about 1½ tons per square centimetre on the inside of the winding, giving a tensile stress on the supporting binding of the coils of 100 tons.

In a continuous-current dynamo or motor of a type not now often used—that is, one with conductors on the surface—we should probably find, per centimetre of circumferential surface of the armature, a current of 300 ampères. The force then would be, per centimetre length of the conductor, $8000 \times 300/10 = 24 \times 10^4$ dynes, or 245 grammes, and this would be a force upon the wire itself. In the case where the wire is buried in slots, as in modern practice, the mechanical force upon the conductor is greatly diminished, and comes upon the iron. The explanation of this rather curious fact was originally given by Swinburne as follows:—The force depends upon the field strength and not upon the velocity of motion in the field; the electromotive force depends on the field strength and on the velocity. Swinburne pictures the lines of force crowding up at the edge of the tooth and then moving across the slot very rapidly, so that the number of lines in the slot at one time is small. As stated above, this would diminish the mechanical force, whilst the density of field being inversely proportional to the velocity of motion of the lines of force, would not affect the electromotive force. In the case of large generators the force upon the conductors in the slots is thus taken into account, but the end connections of the buried conductors are in the open, and are in the leakage field of the magnets, and very special supporting structures are necessary to avoid damage under short circuit conditions, where the forces may be of the order of ¼ to ½ ton per inch length of conductor.

Physical Conception as to Electro-magnetism.—We have seen how the electron at rest or in motion exercises mechanical forces on other electrons and on positive ions. What conception have we of what lies behind these actions? The question is akin to the question, what causes the mechanical attraction between separated particles of matter which we call gravitation? The earlier physicists considered that action at a distance was a quite sufficient answer. They conceived that these actions were brought into existence instantaneously. Faraday realised that the intermediate space was the seat of the activity and explained the actions then known as electrostatic and electro-dynamic as due to a field of force mapped out by lines of force, but he made no attempt to picture the mechanism of this action and, as was pointed out long ago by Tyndall, he had substituted for action at a great distance action at an atomic distance. Maxwell went further, and not only showed the magnitude of the forces, but attempted to visualise a mechanism. In his view matter and empty space was filled with an ether which had a cellular or at all events a filamentary structure, and that between these cells or filaments the space was filled with electricity. Electrostatic phenomena were visualised as a movement of this electricity between the cells in such a way that the cells underwent an elastic distortion, but not a movement from their mean position. The phenomena of electro-magnetism were conceived as being due to rotation of the cells or molecular vortices on the axis of the line of force. The electricity between cells also rotates, but if there is a change in the relative velocity of adjacent cells the electricity will move, this being, in fact, the electric current according to this theory.

According to Maxwell, electricity in its actions exhibited all the properties of an incompressible fluid, it was something continuous. But to-day we know that it consists of separate entities, that is, electrons, and so it is only when we deal with great numbers of electrons that we can consider it as acting as an incompressible fluid. Maxwell himself finally abandoned the attempt to visualise a mechanism and contented himself with the statement of the facts in his equations of the electro-magnetic field. I have, however, described this at some length, because it represents the first and nearly the last effort to give a definite mechanical picture to electro-magnetic phenomena. Whilst the electron has, I think, made easier the conception of what goes on in material bodies, it has made more difficult the conception of what happens in the electric or electro-magnetic field in a vacuum. Mathematical physicists have at present abandoned the attempt to give a mechanistic interpretation of what lies behind the phenomena of attractions and repulsions. Sir James Jeans, recently discussing the various schools of thought in mathematical physics and referring to the school which does not attempt to attach physical concepts to equations or symbols, said:—"The Mathematical physicist of to-day must perforce belong to this school. Most of the symbols he uses convey no physical meaning to his mind, he can explain and predict the whole course of atomic nature in terms of the behaviour of a symbol, the ψ of Schrödinger's wave mechanics, but he cannot tell us what ψ means in physics, and I, for one, doubt if he will ever be able to do so." But there is the other school which without holding out a hope of the sort of mechanistic explanation which physicists sought up to and for a time after Maxwell, believe that they will best express the facts by the definition of "fields" of space. In effect this is equivalent to stating that the final entity is space, that in certain conditions space has certain properties which may be expressed as due to distortions of a special space having particular geometrical qualities, and in which space-field matter or electrons are special points, having no existence other than as a co-existent part of the field. To mechanical engineers this must appear very nebulous, but we must realise that as man progresses intellectually he becomes gradually educated to quite new ideas in philosophy. And just as the ideas of Copernicus, of Galileo, of Newton, of Faraday, of Maxwell were in turn incomprehensible to the men of their day, so gradually from the present evolution of new methods of thought we may believe that explanations of physical phenomena will emerge which will be satisfying not only to mathematical minds, but to that type of thought which constitutes the weapon of the mechanical engineer. To the mechanical engineer there seems no escape from the fact that the actions we have been discussing involve the interchange between visible motion and invisible motion. If we raise a mass from the ground by the utilising of the kinetic energy of visible matter in motion we say it has potential energy, but we cannot mentally conceive of anything having happened except that some invisible motion remains in the space between the earth and the body, which will cease when motion is again given to the mass as it falls to the ground. So when we move electrons from positive ions by mechanical motion it seems that there must be some motion somewhere as the equivalent, representing the mechanical work, which will reappear from the surrounding field when it collapses by the return of the electron to the atom to which it belongs. The fact that we have proved that magnetic fields are due to electron rotations premises again rotational energy as the form of energy hidden from sight, but nevertheless existing, and which we can presently recover from the magnetic field. I cannot but think that eventually these ideas must in some way incorporate themselves in the explanations which will emerge in the future. Very suggestive to my mind are the experiments made thirty years ago by C. A. Bjerknes, Copenhagen, in which he showed that vibrating bodies in a fluid attract one another when vibrating in opposite phase and repel one another when vibrating in the same phase, and that it is possible to show that the fluid is in a state of motion along lines which are identical in form with the lines of force which accompany electrical and magnetic fields.

Physicists having failed to explain magneto-electrical actions which involve wave effects by the old mechanics, are now trying to explain the old mechanics by wave effects, and with very considerable success; but just as Faraday's and Maxwell's conceptions explained action at considerable distance by action at atomic distance, so explanation of atomic actions by wave mechanics must ultimately resolve itself into the question, a wave in what? So always, however far we go, we still see something beyond to strive for, and perhaps it is in this that the joy and satisfaction of scientific inquiry lies.

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It will be recalled that just a year ago the British Engineering Standards Association issued a British Standard Schedule of Colours for Ready-mixed Paints—B.S.S. No. 381, 1930—containing fifty-seven agreed colour patterns with self-explanatory colour names, and the colorimetric value of each colour in the appendices. In response to a number of requests, from those not requiring the scientific colorimetric analysis, for something of less bulk and cost, the Association has published a British Standard Colour Card, which includes all the colours given in the schedule. Everybody interested in the choice of ready-mixed paint, including the housewife, who has always been a most formidable critic where the choice of colour or decoration in the home is concerned, will welcome this new publication. Already it is foreseen that it will become the practice of the householder to give instructions to decorators simply by specifying interior or exterior decoration by the number of the British Standard Colour for each particular purpose or room.

Public Works, Roads and Transport Exhibition.

No. I.

Introduction.

Next Monday, November 16th, the Public Works, Roads and Transport Exhibition will be opened at the Royal Agricultural Hall, Islington, and will remain open for one week. Since we are publishing some description of the exhibits at the Show in advance, we have not yet had the opportunity to view the hall in which the Exhibition is held as it will appear when the doors are opened to the public. Nevertheless, we observe that all the familiar names of firms which have taken part for many years seem to be present, while all the available space has been taken. As was, indeed, to be expected, the oil engine has been developed still further for the purpose of driving rollers, tractors and locomotives, although it has by no means ousted the steam engine for that purpose, as many of the exhibits will show. Following upon the great development of road transport, we mentioned in an introduction to our description of the exhibits at the last Show that more firms than ever were devoting their attention to the production of road signs. That tendency is still noticeable. Although few outstanding new machines have been produced, nearly every firm exhibiting can point to very considerable improvements in its products. In the following articles descriptive of some of the exhibits we have endeavoured as far as possible to confine our remarks only to those exhibits which are entirely novel or only recently produced, and to machines or other products which we have not previously had an opportunity to describe, but which we believe will be of interest to our readers.

Hadfields Ltd.

The exhibits of Hadfields Ltd., of Sheffield, will consist mainly of stone breakers and accessories for road-making purposes. The plant is of the Hadfield standard design and comprises a portable crushing and screening plant, a granulator, which is illustrated in Fig. 1, and a 24in. disc crusher. The first consists

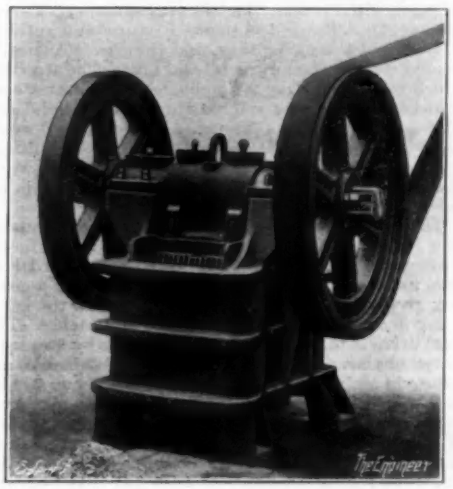

Fig. 1—Single-Toggle Type Granulator—Hadfields

of a solid steel stone breaker of the double toggle type, a revolving screen for grading the stone into various sizes, and a feeding platform carried by a structure mounted on wheels with broad treads. The plant, which weighs about 7 tons, can give an output of between 7 and 10 tons per hour of stone crushed sufficiently to pass through screen holes 2½in. in diameter.

The granulator—Fig. 1—is of the single toggle type and, having a steel body, is very light and strong for its capacity. It is suitable for the production of top dressing material.

Besides the third machine—a disc crusher—mentioned above, Hadfields Ltd. will exhibit mining drills, high-speed tool steel, "Era" manganese steel furnace parts, and road studs for the guidance of traffic.

Ruston and Hornsby, Ltd.

The stand taken by Ruston and Hornsby, Ltd., of Lincoln, will be made particularly interesting by the fact that the firm is here introducing for the first time a new light oil engine driven roller and a new oil engine locomotive. These machines are illustrated in Figs. 1 above and 13, page 518. The firm has been marketing for some time a range of oil engine driven road rollers, and the new machine has been introduced to meet the demands of those who require something lighter, having at the same time the very small fuel costs associated with the use of this type of prime mover.

In working order the roller weighs 2½ tons, of which water ballast accounts for 7½ cwt. The width rolled by the standard machine is 4ft. 1in., but special wheels for grass rolling can be supplied to give a total width of 6ft. The engine, of 5 B.H.P., runs at 600 r.p.m. and the fuel consumption is stated by the makers to be no more than 1½ gallons per working day of eight hours, costing approximately 7d. A four-speed gear-box is fitted, giving speeds at full engine revolutions of 4, 2, 1½ and ¾ miles per hour in either direction. The reverse gear is of the Ruston double-clutch type, which does not necessitate disengagement of the gears when operated. All the gears, the clutches and the operating mechanism are enclosed in the gear-box, being thus protected from dust and moisture. The engine is a single-cylinder airless injection oil engine running on the four-stroke cycle at 600 r.p.m., constructed by R. A. Lister and Co., Ltd., of Dursley, which is now associated with Ruston and Hornsby, Ltd. It is started easily by hand from cold and will run on paraffin, gas oil, solar oil, or Diesel light fuel oil. The frame of the roller is constructed of rolled steel sections and plates, being designed to give great strength without rendering the engine and other parts inaccessible. The rollers themselves are built entirely of steel and the nave, discs, and rims are electrically welded together to form one solid unit. The steering, which is controlled by a hand wheel placed at a convenient angle in front and towards the right-hand side of the driver, operates through a hardened steel worm gear. Two powerful independent brakes are fitted, one operated by hand and the other by the foot, while the reversing gear can also be used for braking in an emergency.

The locomotive which is the subject of the illustration Fig. 2 is driven by a Lister 10 H.P. two-cylinder vertical oil engine running at 600 r.p.m., similar to that used on the roller. The drive is through a gear-box giving three speeds in either direction, the gears being in constant mesh and selected by clutches. The final drive is taken to the driving wheels by two steel roller chains. The draw-bar pulls obtainable are approximately 1200 lb. at 2½ miles per hour, 700 lb. at 4 miles per hour, and 450 lb. at 6 miles per hour, those speeds corresponding to the maximum for each of the three gear ratios. These figures correspond to hauling capacities based on an adhesion of 425 lb. per ton and a rolling resistance of 22 lb. per ton of 52 tons at 2½ miles per hour, and 20 tons at 6 miles per hour on the level. The frame of this locomotive is built up of rolled steel sections electrically welded together. The makers claim that gear changing is simple and easy, so that the driver has every incentive to travel at the fastest possible speed.

Marshall, Sons and Co., Ltd.

The exhibits of Marshall, Sons and Co., Ltd., of Gainsborough, will cover nearly the full range of the firm's productions. Many of the machines to be shown are already familiar to our readers. We have chosen for illustration two, exemplifying the fact that the firm is ready to make rollers and tractors, either steam-driven or propelled by the more recently developed oil engine. The steam road roller illustrated in Fig. 14 on page 518, has been built by the firm for many years, and during that time many improvements have been made to it. It is designed to fulfil the dual requirements of a roller for ordinary consolidation work, and for laying asphaltic and similar surfacings. An interesting feature of the machine is an arrangement by which the rear rollers can be set at an angle to each other for the production of roads having cambers up to 1 in 24. The rear axle is articulated and the axle arms are positively adjustable to any inclination, setting to any angle being accomplished by means o a handle, while an indicator shows the camber for which the rolls are set. The transmission includes a double drive to the main road wheels through a differential on the intermediate shaft.

The other engraving—Fig. 3—illustrates the latest model of the oil engine driven industrial tractor made by the firm and shown on the stand. The power unit is a two-stroke, single-cylinder, horizontal engine, developing 15–30 B.H.P. The bore is 8in. and the stroke 10½in., and the engine runs at 550 r.p.m. Three forward speeds and a reverse are provided, giving travelling speeds of 3, 5·25, and 8·75 m.p.h. forward and 3·75 m.p.h. in reverse. The hauling capacity is approximately 4½ tons on a 15 per cent. gradient and 15 tons on a 3 per cent. gradient, while the weight of the tractor itself is 3½ tons. The fuel consumption is given as about 0·48 lb. per B.H.P. hour. For belt work, power is taken from a large pulley fitted to the end of the engine crank shaft, running at full engine speed. The tractor is fitted with single solid rubber tires on the front wheels and twin tires on the rear wheels, which have drop-in grips. The general neat and workmanlike appearance of the machine will be seen from the engraving.

The firm is also exhibiting a 6-ton oil engine driven road roller and the "Manumit" motor rollers, besides concrete mixers.

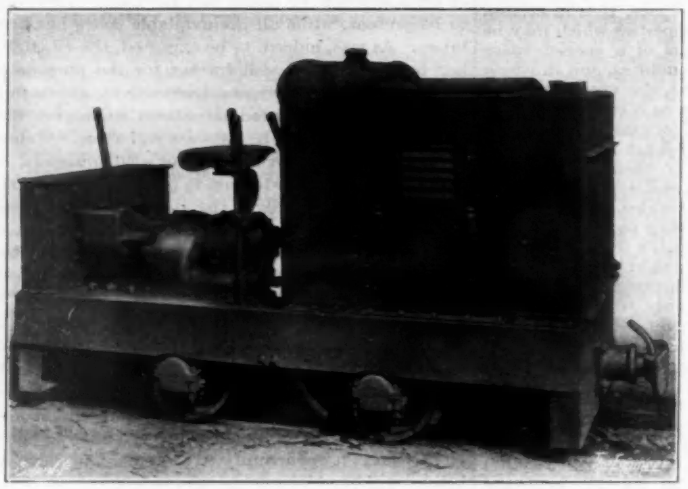

FIG. 2—10 H.P. OIL ENGINE-DRIVEN LOCOMOTIVE—RUSTON AND HORNSBY

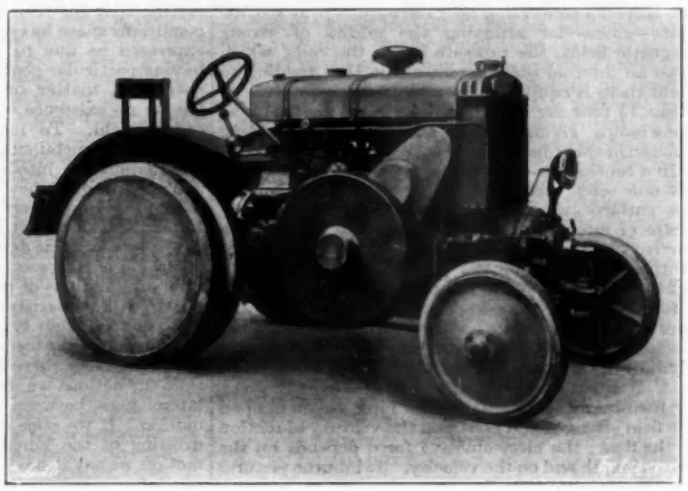

FIG. 3—15-30 B.H.P. OIL ENGINE-DRIVEN TRACTOR—MARSHALL

Barford and Perkins.

Motor rollers of various sizes and types will make up the exhibit of Barford and Perkins, Ltd., of Peterborough. In the view given in Fig. 16 on page 518, we illustrate an 8-ton motor roller driven by a Blackstone two-cylinder vertical airless injection oil engine developing 18–20 B.H.P. at a governed speed of 1000 r.p.m. The fuel consumption is given at 2 to 3 gallons per working day. The roller is constructed with a patented design of sub-frame, which, while giving a low centre of gravity, also enables the engine and the transmission to be removed without dismantling the whole machine. Three speeds are available in either direction, giving 4½, 2¾, and 1¼ m.p.h. Forward and reverse motions are controlled by means of two cone clutches operated by a hand lever. Power and hand steering gears are fitted. The rolling width is 6ft. 4in. and the machine is provided with scarifiers.

A small roller, weighing only 19 cwt., is a recent production. It is of the tandem type, designed for rolling small areas of grass or narrow footpaths, and is suitable for tennis courts of both grass and hard varieties. It is driven by a 4 H.P. two-stroke petrol engine, and runs at a normal speed of 1½ m.p.h. Higher or lower speeds can be obtained, however, by the use of the throttle. The makers state that the machine is exceptionally easy to control. It can be turned within a circle 16ft. in diameter.

The remaining exhibits will all be standard productions of the firm, to which minor improvements have been made. The heaviest machine weighs 13 tons and the lightest less than 1 ton. The variety covers the whole range of rolling requirements.

Aveling and Porter, Ltd.

The firm of Aveling and Porter, Ltd., of Rochester, has been known for a very long time for its rollers, some of which, made fifty years ago, are still in use. At the Exhibition several types, both steam and oil engine-driven, will be seen. That shown in Fig. 15, page 518, is a 14-ton oil engine driven roller, designed to deal with every form of road rolling and scarifying. It is provided with four speeds in either direction, and is fitted with three-tine scarifiers. The frame, which is of all-steel construction, is very heavily made to resist the severest conditions. It is claimed in this connection that the elimination of castings gives additional security against the effects of the heavy shocks the rollers are certain to encounter in service. Reverse is engaged by means of clutches, which give the rapid reversal of motion that is so important when rolling hot asphalt and the like. The power unit is an airless injection single-cylinder oil engine, with the low running costs associated with that form of prime mover. A special slow-running gear is provided, by means of which road speeds as low as ¼ m.p.h. are made possible.

Other exhibits on the stand will be concrete mixers and the "Invicta" high-speed oil engine, with which our readers have already been made familiar.

The Lead Wool Company, Ltd.

Examples of "lead wool" for a variety of jointing purposes are exhibited by the Lead Wool Company,

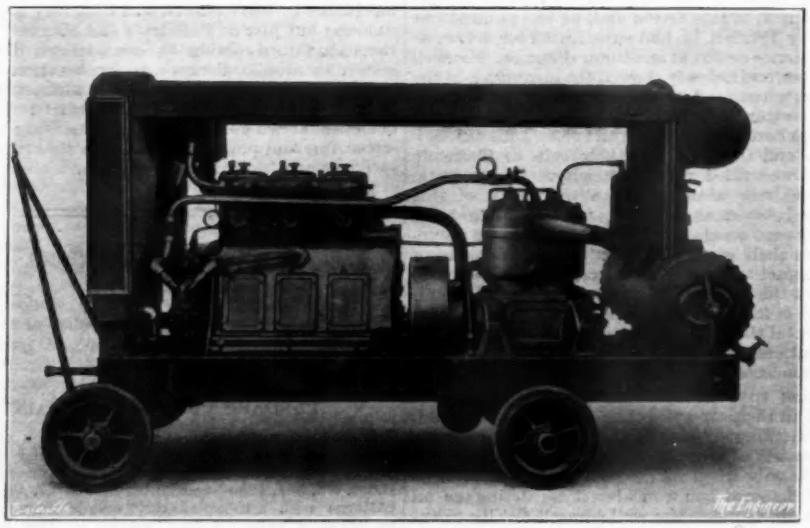

FIG. 4—PORTABLE OIL ENGINE-DRIVEN COMPRESSOR—LEAD WOOL

Ltd., of Snodland, Kent, which is also showing two portable air compressors and patented joints and testing plugs. One of the compressors, a petrol engine driven one, we described two years ago on the occasion of the last Public Works Exhibition. The other, driven by a Lister oil engine, is illustrated in Fig. 4. The engine has a bore and stroke of 4½in. by 5½in., and develops 27 H.P. in three cylinders at

1000 r.p.m. In design it is similar to those to be seen on the stand taken by R. A. Lister and Co. The guaranteed consumption at full load is 0·43 pint per B.H.P. hour. The compressor has two cylinders, 5½in. bore by 4½in. stroke, both cylinders and valves being well water jacketed, and the piston displacement at full speed is 112 cubic feet of free air per minute. The machine is force-lubricated by means of a positive pump driven off the crank shaft. The automatic unloader valve fitted lifts the suction valves off their seats when the predetermined receiver pressure is reached, amounting normally to about 100 lb. per square inch. The engine then runs under light load until the fall of the receiver pressure releases the

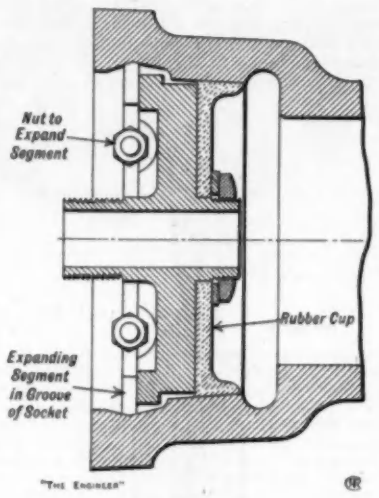

FIG. 5—TESTING PLUG—LEAD WOOL

suction valves. The receiver is tested to 250 lb. per square inch. It is fitted with a hand-hole for cleaning purposes, a large-capacity relief valve pressure gauge, and five air cocks. The engine and compressor are mounted upon an undercarriage built of channel steel and fitted with wrought iron rubber-tired wheels.

The other illustration accompanying this article—Fig. 5—is a drawing showing how the main testing plug made by the firm is fixed in the end of the pipe to be tested. The actual seal against the pressure is provided by a rubber cup behind which and supporting it is the main body of the attachment which is an easy fit in the bore of the pipe. The attachment is held in place by means of two expanding segments held together by links which can be extended by the use of a spanner.

INGERSOLL-RAND COMPANY, LTD.

Two new machines will be exhibited at the Show by the Ingersoll-Rand Company, Ltd., of Queen Victoria-street, London. The two-stage air compressor illustrated in Fig. 6 has been developed for use particularly in garages where many of the tools are operated by air pressure. It is supplied on a variety of mountings, such as trolleys, on a light framework with wheels, or on castors. In the illustration it is shown with a stationary mounting. It will be seen that the set consists of an electric motor and a two-stage compressor mounted upon the top of a large air receiver. The motor drives the compressor by means of a double "V" belt. The compressor cylinders are air cooled, being provided with cooling fins, while the fly-wheel is designed to act as a fan and drive a current of air over them. The

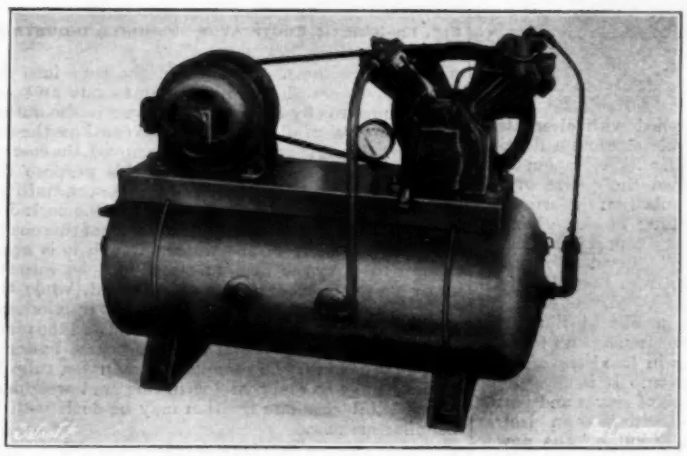

FIG. 6—TWO-STAGE AIR-COOLED COMPRESSOR SET—INGERSOLL-RAND

compressed air passes from the low-pressure cylinder to the high-pressure through a copper tube provided with fins—in the larger sizes more than one tube is used—which is placed within the stream of air from the fan. In this way intercooling is effected. The compressor is fitted with plate valves and runs on ball bearings, and a centrifugal unloader unloads both high and low-pressure cylinders. These compressor units are made in a range of sizes from ¾ to 10 H.P. For the smallest size the bores and strokes are 1¼in. and 3in. by 2in., while for the largest the corresponding figures are 3½in. and 6in. by 4in., the piston displacements being 3·9 cubic feet per minute and 41 cubic feet per minute respectively. The units operate against a discharge pressure of 200 lb. per square inch. A single-cylinder compressor operating against a discharge pressure of 100 lb. per square inch is also constructed, particularly for providing air for motor vehicle tires.

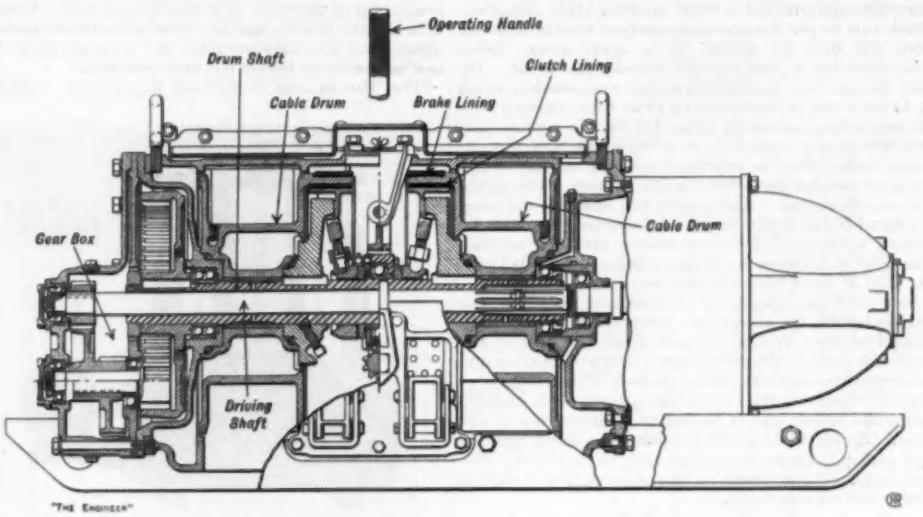

FIG. 8—SECTION THROUGH DOUBLE-DRUM HOIST—INGERSOLL-RAND

The other new machine brought out by the firm is the electric hoist illustrated in Figs. 7 and 8. Consulting the drawing, Fig. 8, it will be seen that the electric motor bolted on to one end of the hoist drives a central shaft. At the end of the machine furthest from the motor there is a gear box which is tightly sealed to exclude dirt and retain the lubricant. The gears run in grease and consist of three stages of simple reduction, each gear being mounted upon ball bearings. All except the final pair are of helical form to ensure quietness of operation. The final drive is of the internal gear type, and has straight teeth. The internal drum gear drives the hollow drum shaft, through the centre of which projects the driving shaft. The drum shaft is supported on heavy-duty ball bearings housed in the two covers of the hoist. The drive passes to the two drums through internal expanding clutches operated by a single lever to be seen projecting upwards from the back of the hoist in the engraving, Fig. 7. The mechanism is so arranged that only one drum at a time can be put into operation. The drum shaft runs continuously, and a large ball bearing is provided in the clutch yoke to take all the clutch thrust. When not engaged by the clutch the cable drums run idle on the drum shaft. Each drum is fitted with a brake operated by a foot pedal.

Referring now to the photograph reproduced in Fig. 7, it will be seen that a housing completely encloses all the working parts, and that over and at the sides of the cable openings rollers are so placed that any chafing of the cable is prevented. The rollers are mounted upon adjustable Timken roller bearings.

The hoist is suitable for use with ⅜in. or ½in. cable, the capacities of the drums for the two sizes being 500ft. and 300ft. respectively. It is mounted upon skids and weighs 1620 lb. when fitted with a 15 H.P. A.C. motor and has a rated capacity for vertical lift of 2000 lb. and an average cable speed of 240ft. per minute. Its dimensions are 58¾in. by 29¾in. by 27¾in. Besides the two machines just described, the company is showing a wide range of equipment for road-breaking, tunnelling, quarrying, and general demolition work. Some of the tools and machines shown will be of Canadian manufacture.

FIG. 7—DOUBLE-DRUM ELECTRIC HOIST—INGERSOLL-RAND

R. A. LISTER AND CO., LTD.

Our readers are already familiar with a very large number of the products of R. A. Lister and Co., Ltd., of Dursley. It is for this reason that we have chosen

FIG. 9—10 H.P. PORTABLE SPRAY-COOLED OIL ENGINE—LISTER

for description and illustration from the auto-trucks and engines exhibited by the firm the spray-cooled portable oil engine set, of which a potograph is reproduced in Fig. 9, as it is a recent production of the firm. It will be seen that it comprises a two-cylinder oil engine and a special water-cooling device mounted upon a steel-frame trolley. The engine runs at 600 r.p.m., and gives 10 H.P. Starting from cold is facilitated by the patented arrangement of the combustion chamber, which was described in our issue of May 16th,

1930. Our readers will recall that the clearance between the piston at the top of its stroke and the cylinder head is very small, the air being forced into a spherical chamber in the head, into which the fuel is sprayed. A small orifice in the side of this spherical chamber communicates with another such chamber, which can be put into communication with or shut-off from the first by means of a screw-down valve controlled by a hand wheel outside the head. By this means the normal running compression ratio of 15 to 1 can be increased to 19 to 1 for starting, the corresponding pressures being 450 lb. per square inch and 600 lb. per square inch. When starting the exhaust valve lifter is operated and the engine swung for a few revolutions when, on the release of the valve, the engine starts. As soon as full speed is attained the hand wheel controlling the clearance valve can be turned to reduce the compression ratio to normal. The firm guarantees a consumption figure of 0·5 pint per B.H.P. hour from the engine.

The cooling equipment is designed to allow the engine to run for about five hours without the addition of water. Water is drawn from the base of the cooler by means of a centrifugal circulating pump and delivered through the water jackets of the engine to a spray pipe mounted over a wire screen. It is sprayed on to the screen and is cooled as it runs down to the base. The circulating pump is driven by a belt running on a pulley between the engine and the fly-wheel. The fuel tank can be seen in the illustration mounted above the cooling tank.

Ruston-Bucyrus, Ltd.

A number of modifications and various improvements have been made in the design of the ½ cubic yard excavator manufactured by Ruston-Bucyrus. The machine to be exhibited, which is illustrated in Fig. 10, is driven by a Ruston two-cylinder oil engine with a consumption of about ¾ gallon per hour, but a petrol engine or an electric motor can alternatively be fitted. The new model has an entirely new caterpillar mounting having a cast steel bottom frame, single shaft drive, and a final chain drive. The single shaft chain drive has been adopted because by its use many of the moving parts necessary in a gear drive are dispensed

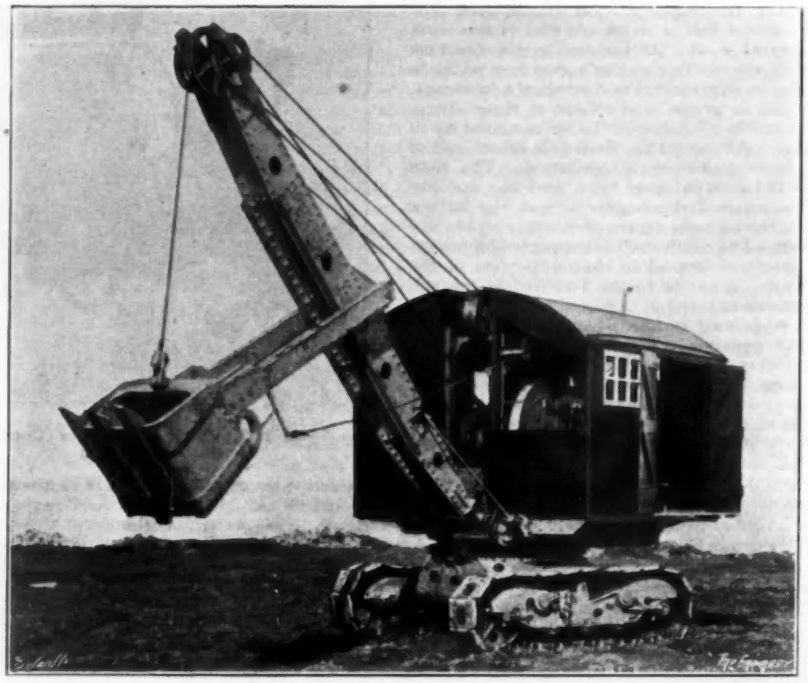

FIG. 10—½-CUBIC YARD EXCAVATOR—RUSTON-BUCYRUS

with, while it is also very simple and very accessible. A two-speed travelling gear is fitted above the platform out of the way of mud and dirt. Each of the caterpillar tracks with its side frame, sprockets, rollers, &c., is a complete unit. These units are carried by two "dead" axles taking the whole weight of the superstructure. The load is distributed over five points on each track. A steel box girder boom is fitted to the machine and provides ample strength, while at the same time it is light. The shovel bucket is of mild steel and has been re-designed to give greater efficiency. All the controls are conveniently arranged for the driver, who can set in motion any of the travelling and steering operations with the superstructure in any position.

Mining and Industrial Equipment, Ltd.

It is curious to reflect how much modern methods of production and how many foods and materials of use to the human race depend for their value on efficient grading. That the bread we eat should depend for its quality on the efficient grading of the flour, and that paints would be of no value without proper selection of the sizes of the particles forming the pigments, is taken for granted, but a little reflection will show that at some stage in its production nearly every one of the products of to-day depends upon the proper selection of the limits of size, either great or small. That is the same thing as saying that man has found it inefficient to treat at one time a material consisting of particles of widely mixed sizes. Grading is in essence merely another form of accurate measurement, and the more accurate the measurements that can be made the better the final product.

The Mining and Industrial Equipment Company,

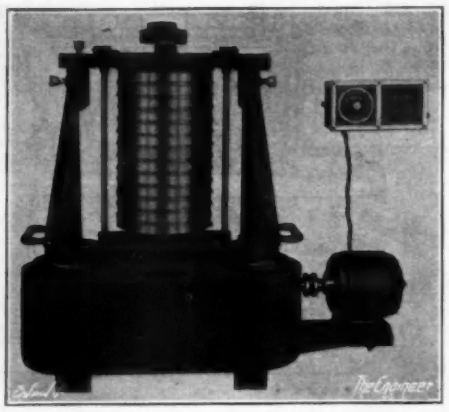

FIG. 11—SIEVE TESTING MACHINE—MINING AND INDUSTRIAL

Limited, which has specialised for many years in the production of screens, has supplied screening plant for a very wide variety of purposes. The "Hummer" vibrating screens are well known already. They consist of an electric vibrator working on a principle analogous to that of an electric bell, mounted on a cross bar above the screen itself, which is supported in such a way that the vibrations communicated to it are spread over the whole screen cloth. The vibrator consists of a magnet coil supplied with alternating current which at every half cycle attracts a floating laminated armature transmitting its vibration to a spring steel strip attached down the centre of the screen cloth. At each current pulsation the armature is attracted and hits two striking blocks, giving a jarring vibration at the rate of about 1800 times a minute. For the "Hummer" shown the power required is 0·25 kW at 118 volts from 15-cycle single-phase supply.

The photograph reproduced in Fig. 11 illustrates a machine which reproduces the circular and tapping motions given to testing sieves in hand sieving, but with a uniform mechanical action. It is capable of accommodating six standard height sieves and is run by a ¼ H.P. motor. Associated with it is an electric switch, which will automatically cut off the power after any suitable period according to its setting, thus relieving the operator to devote his time unworried by the clock to some other work.

A kinetic elutriator to be exhibited on the stand has points of very considerable interest. The apparatus is illustrated in Fig. 12. The feed tube A at the top of the instrument is charged with the sample of powders to be tested. The vent at the bottom of this tube is so small that the particles are prevented from discharging by the surface tension film across its mouth. The test is started by opening the inlet cock M at the bottom, and adjusting the rate of flow of the water by means of the piezometer tube B near the outlet. Three sizes of orifice for regulating the outflow of water are supplied with the apparatus. By opening the vent C momentarily the water is allowed to rise and cover the outlet of the feed tube. The powder can then descend slowly while water rises to take its place. The particles descend through the central tube D into the large conical vessel G, collecting at the bottom. The accumulation of particles here nearly prevents the flow of water through the annular space between the central fitting F and the walls of the vessel G, so that almost all the water passes up the passage in the central fitting, carrying with it the particles and impinging them upon the underside of the umbrella-shaped fitting E. This action has the effect of breaking up aggregations of particles. The

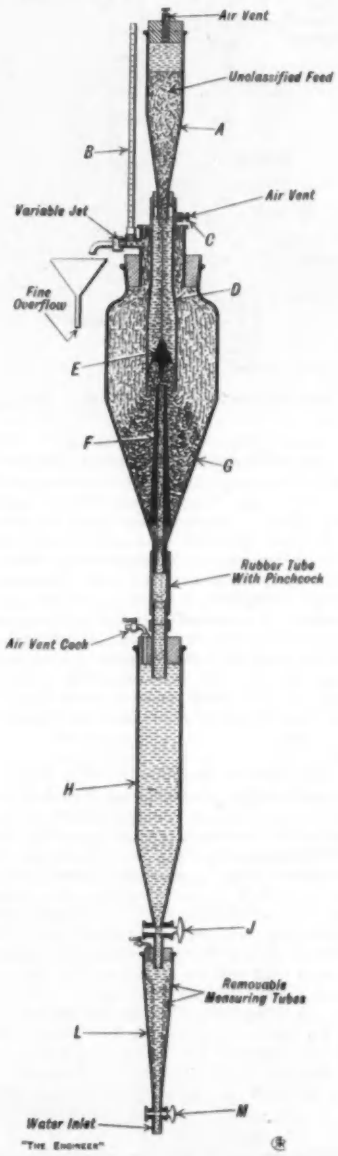

FIG. 12—KINETIC ELUTRIATOR—MINING & INDUSTRIAL

particles pass down again out of the tube into the vessel G, where the lighter separate out and are carried upwards by the stream of water to the outlet, while the heavier fall to the bottom to continue the circulation. The fine particles being removed, the coarser residue can be subdivided. For this purpose the cock J is closed, allowing the residue to descend into the vessel H. When it has all passed down the cock J is reopened. Owing to the smaller diameter of this chamber H the velocity of the water through it is great enough to carry the medium-sized particles into the upper vessel G, where they are trapped, while the coarser particles remain below. The two fractions are isolated by simultaneously closing cock M and the pinch cock between vessels G and H. The coarse material then descends into the removable graduated tube L, whence it can be removed for drying and weighing, while the intermediate fraction may be dealt with in a similar manner.

(To be continued.)

The British Engineers' Association (Incorporated).—At a meeting of the Council of the Association, following the nineteenth Annual Ordinary General Meeting, held at the Hotel Victoria, London, W.C. 2, on Thursday, November 5th, 1931, Mr. William Reavell was unanimously re-elected President of the Association for the ensuing year.

A New Nut-Forging Machine.

THERE has recently been evolved a machine for making the blanks for "black" nuts, which suggests that a very considerable saving may be made in the amount of scrap ordinarily produced by the Oliver machine. It is the invention of Mr. H. Maplethorpe, of 186, Hill-top, West Bromwich, Birmingham, and is the subject of the illustrations which we reproduce herewith.

The process of stamping out nut blanks from a rectangular bar, by means of an Oliver, is familiar to our

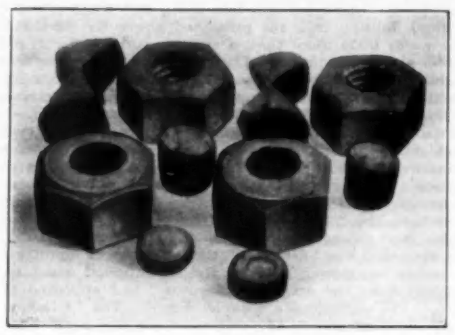

FIG. 1

readers. It results in a considerable amount of scrap being produced, as is shown in Fig. 1, in which the top row of nuts has been produced by that process. The scrap represented by the corner bits and the slugs punched out from the centre represent about one-third of the total material used, and although such scrap is readily marketable, it is obvious that its reduction would be advantageous.

When nuts are made by the Maplethorpe process, the scrap is reduced to the small pellets seen in the foreground of Fig. 1, which represents two groups of ½in. nuts. The pellets are only about ¼in. thick, and it requires ten of them to make 1 oz. Incidentally, the nuts are made from a round bar of stock, which is generally more readily available than a specially sized rectangular section.

Put very briefly, the process consists in pressing a hot cylindrical blank out into the salient angles of a hexagonal die and punching a central hole, in a series of five operations.

Before going on to describe the machine, it may be as well to explain the sequence of these operations, which are indicated in the diagram, Fig. 2. A hot blank A is brought into position by a carrier B, in front of the die C in the plate D. This die is backed up by the bolster E and into it the blank is pushed by the ram F. The plate D then moves one step forward and the ram G, advancing, squeezes the blank out, more or less, into the hexagonal form of the die C. There is another step and a punch advances, which not only partially perforates the blank—for the bolt hole—but also pushes out the material to fill the corners of the die. At the next step a longer punch completes the perforation against a hollow bolster, and produces the little wads shown in Fig. 1. These wads are led away to the waste bin, and the final step is made, the finished nut blank being expelled through a larger opening in another bolster.

The general appearance of the machine which effects these processes is shown in Fig. 3; while the diagram, Fig. 4, gives an idea of the essentially novel features.

It will be seen that it has the general characteristics of a bending or forging machine, with the driving pulleys K—see Fig. 3—and the spur reduction gearing L M. The first motion shaft is 3in. in diameter in the case of a machine for producing ¼in. or ⅜in. nuts, and the pinion has teeth of 1¼in. pitch by 6in. face. The crank shaft to which the spur wheel M is keyed is 4½in. in diameter, and has a throw of 2½in. It operates the connecting-rod N and through that rod the punches and rams mentioned in connection with Fig. 2. These tools are arranged around a circular collar—as shown at G H J in Fig. 4—and, although there are spaces for six tools in the machine as arranged,

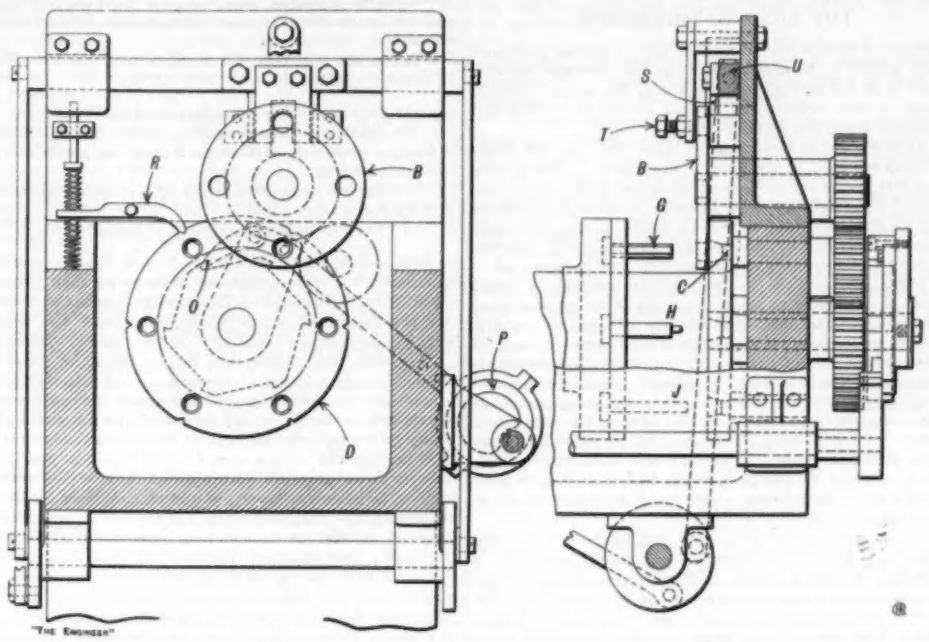

FIG. 4—PUNCH AND RAM OPERATING MECHANISM

only five are really necessary for the work. The sixth space is left blank. The slides for the tool head are provided with arrangements for taking up wear.

In front of the tool head there is the die plate D, which can be rotated, step by step, by the ratchet gear O and excentric P, Figs. 3 and 4. A detent R serves to fix the plate in register at each move. (The top of the die plate can just be seen at D in Fig. 3.)

It will be seen that, by the intermittent rotation of the die plate, the dies, which are filled with hot blanks, are brought into position for operation upon by the tools in the slide, as recounted in Fig. 2.

The hot blanks are fed into the machine by the feed disc B—Figs. 3 and 4—in the following manner:—A hot bar of appropriate size is pushed through the opening S—Fig. 4—against the stop T, and is sheared off by the knife U against the face of the plate B. This shearing action is effected by the rod V—see Fig. 3—and an excentric on a cross shaft. It should be pointed out here that while the drawing, Fig. 4, indicates the essential actions, it does not represent the working details, as the shearing is effected by a cam action in the box W—Fig. 3—and not by a plain yoke, as shown in Fig. 4.

The blanks cut off by the shear are held in the feed plate and are carried round with its rotation to face the dies and be dealt with, as indicated in Fig. 2. A water-cooling service for the punches and dies is provided by the manifold X—Fig. 3.

We have before us some samples of nuts made by this process, and although the corners may not be very keen, they are amply substantial to take the pull of a spanner for several rounds of tightening up; but, above all, the saving in scrap metal effected by making nuts in this way is worthy of serious attention. The machine is capable of producing ¼in. or ⅜in. hexagon nuts at the rate of about fifty per minute from ⅞in. or 1in. round bar respectively.

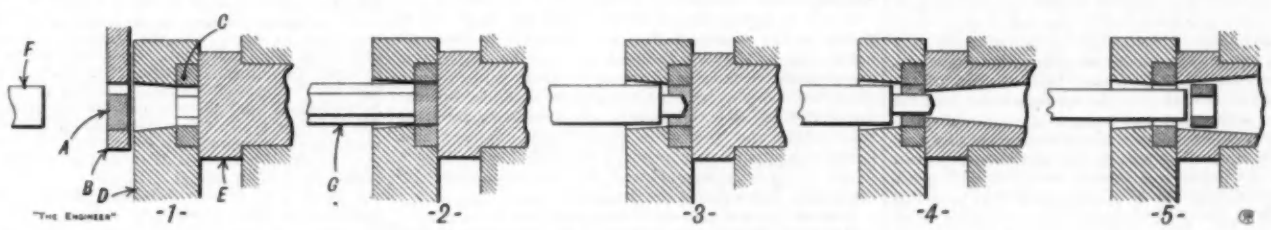

FIG. 2—SEQUENCE OF OPERATIONS IN FORGING NUTS

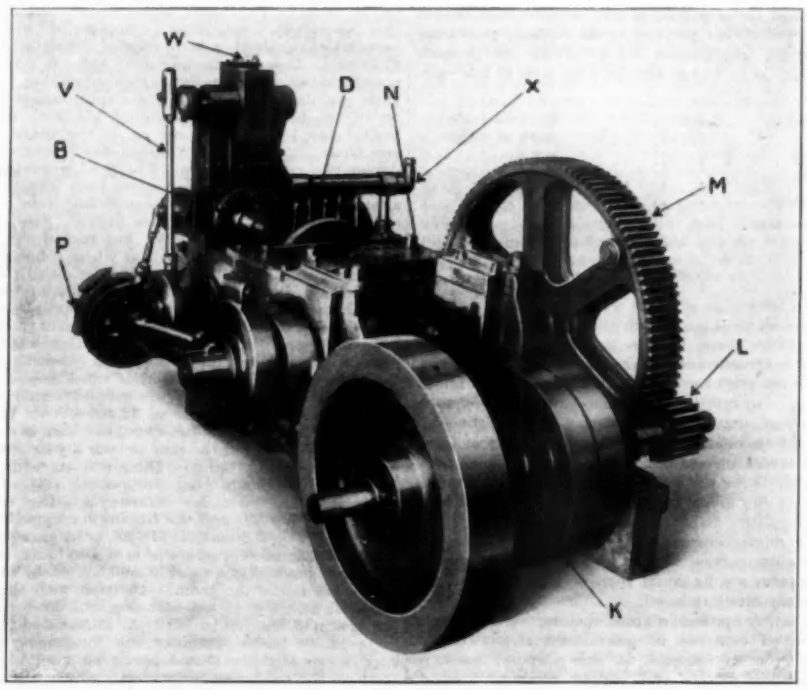

FIG. 3—MAPLETHORPE NUT-FORGING MACHINE

NEW YORK'S most luxuriously furnished hotel, the Waldorf-Astoria, has been equipped with what is probably the most elaborate radio receiving system in existence. According to the *Wireless World*, a total of 2000 loud speakers are fed from a central control panel, which measures 50ft. in length and looks like the master control panel of a powerful broadcasting station. Six different programmes are available at all times in any one of the 1940 guest rooms. Six broadcast receivers, linked to a single aerial 600ft. above the street, are used to feed the control panel. Provision is made on the control panel for the handling of any speeches, musical entertainments, &c., which may be given in the hotel, to be relayed by wire to the broadcast networks for transmission to all parts of the country. Microphones can be plugged in to any one of seventy-two positions in different parts of the hotel, where events of importance are likely to occur. In addition to the smaller speakers in the guest rooms, all the public rooms are equipped with large exponential horn speakers, each 6ft. high, which are concealed behind grilles.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE ROAD TO PROSPERITY.

Sir,—Now that the turmoil of the election is over, and there seems to be nothing to stop the National Government from taking real steps to aid in the return to prosperity of this country, let us look ahead in another and probably more important direction.

At a dinner in London a week or two ago, Sir Hugo Hirst is reported in the Press to have said: "But I warn you that tariffs are not a solution unless tariffs are accompanied by efficiency in industry. Inefficient industries cannot shield themselves behind tariffs." Are the manufacturers and industrialists of this country going to follow that up? Unless they do, we are not greatly better off.

There appeared in the daily papers recently a notice which is extremely significant in view of the present state of things, political, industrial and financial, in this country. I refer to the statistics published by Austin Motors, of Birmingham, one of the leading motor car manufacturing concerns in the world at the present time, and I would draw particular attention to the following sentences which appear among the statistics relating to their record year: "Cars sold in home markets 26 per cent. more than previous years. A safeguarded industry. Selling prices reduced 65 per cent. since McKenna Duties were introduced. Productive wages paid averaged 2¼ times trade union rates."

The impression made on the "man in the street" who reads this very satisfactory announcement probably is that the McKenna duties are wholly responsible for the increased and growing prosperity of the firm; but the matter goes much deeper than that. The drop in selling prices—and paying high wages, mark you—could never have exceeded the advantage due to the imposition of the McKenna Duties, as it must have done, unless the directorate of the firm had adopted the mentality that they would sell their cars in face of all competition, home or foreign; that is to say, on a price-for-equal-merit basis, and organised their factory methods to anticipate that state of things. Protective duties give a sense of security to the manufacturer, give him a leg-up in the home market, and a clearer incentive to organise for meeting the foreigner on his own ground and price, but by themselves they would not bring a great deal of business to the manufacturer.

In all this welter of argument and discussion—political, financial, international—it is easy to lose sight of the fact; for fact it is that it is the manufacturer, and the manufacturer only, that can bring real industrial prosperity back to this country. The Government, by protective duties and other means, can and should protect him against the unfair competition of "dumped" goods in our home market, but it cannot assist him in selling British goods in foreign countries, as he will have to do if we are ever to regain our position as the premier industrial nation of the world. What are "dumped" goods? In crude language, they are goods which are sold at a price that covers the total cost of wages and material, and only as much of general factory expenses as will keep the selling price well below that of competitors.

If the manufacturers of the country as a whole will realise—

(1) That the idea "British goods are best" is as dead as the Dodo;

(2) That they have to sell in this country or abroad at prices which are equal to or lower than foreign competitive prices, or they will not sell at all; and

(3) That they must organise their manufacturing to meet that competition or go out of business;

then, and not till then, shall we have turned the corner and be in a position to regain prosperity.

At present some manufacturers—notably in the motor car and electrical industries—have realised this; but far too many are still thinking on the lines of forty or fifty years ago, many are using methods of that period—I know of one big firm which is using productive machines made in 1865 and wondering why its trade is going—and when a period of depression like the present comes, all they do is to whine that the Government should protect them with tariffs, and that the wages they pay must be reduced as they are so much higher than continental wages. Rubbish! It makes one sick to listen to it. Here is the Austin Company paying wages well above the average in this country, let alone the Continent, reducing the selling price of their cars, and yet they can pay a 100 per cent. dividend to their shareholders. They know their business. Look at the Ford Company, who are supposed to pay the highest wages of any engineering manufacturing business in the world, and sell their products at enormous profit all over the world. Look at some of the big electrical engineering concerns. Plenty of work, paying good wages, selling all over the world, and yet paying dividends which, if not large, are at any rate well up to the standard of a prosperous engineering concern in my younger days. Why can these people get business and keep going, even in times of acute depression like the present, in face of the lack of tariffs and high wage rates which others say make it impossible for them to get trade? Tariffs are only a partial reason; wage rates are not the answer; salesmanship does not account for it, for no salesman can sell goods which on account of their high price are unsaleable.

The real kernel of the matter is that our factories are, as a whole, out of date and badly managed. His Royal Highness the Prince of Wales, after his recent visit to South America, pointed it out, and showed a clearness of vision about it far ahead of the men to whom he was talking—the manufacturers themselves, the specialists in production. The trade unions realise it to some extent and resist reduction of wages, though the various extremist elements of those organisations manage to so obtrude their unreasonable demands that this and other aspects of the question realised by the saner elements are almost entirely obscured.

What is the real cure for our lack and loss of trade? It may be summed up—

(1) Reorganise our manufacturing methods.

(2) Establish branch works inside tariff-protected foreign countries, staffed as largely as possible with British labour.

(3) Impose protective tariffs to give an advantage in the home market; and

(4) Keep taxation of industry to a minimum.

How can (1) be carried out? It is a difficult question to answer, but it has got to be done or we shall lose our place in the industrial nations and be unable to sustain our population, of whom many, and those the won't-workers, are already being kept on the nation's charity.

The fault undoubtedly lies largely with the directing bodies, usually a board of directors, of the manufacturing firms. One notices that public companies where the board is exposed to the slings and arrows of the shareholders if things go wrong form the bulk of the successful concerns. One notices the crying evil of the "guinea pig," the director who gets his job without any qualifications, because he has an attractive sounding title or is a relation of existing directors, and often has not even a substantial financial interest in the concern. One notices also that the evils of incompetent directors and bad management are much more prevalent in private companies where the shareholders are selected by the directors, and there is no outside means of protesting against incompetence.

Why not, then, abolish the private company? Wherever shareholders exist, permit them to deal with their shares as they will, publish the company accounts, and throw the directors open to trouble from the shareholders if things are going wrong; indeed, I should advocate giving shareholders more information and power than they have at present. I believe the move would be of very great benefit to the company and would do away with a lot of the incompetence which is the real cause of the industrial decline of this country.

It will be argued that it will be dangerous to put more power in the hands of the shareholders. In Heaven's name, why? They are the real owners. If a majority of shareholders wish to take action which is going to prejudice the company, surely that is better than incompetent directors doing so. And there is no reason to suppose that shareholders are any more stupid than anybody else. Given competent management, the shareholders will back it up. It is only incompetent directors of unsuccessful companies that will feel the draught.

Remedy (2) is a matter of individual action.

Remedies (3) and (4) will, we hope, soon be accomplished facts.

I must apologise, Sir, for having taken so much of your valuable space.

H. O. Wraith.

London, S.W. 1, November 4th.

STEEL FOUNDRY COSTS.

Sir,—I shall be very glad if you or your readers will state the detailed cost per ton in the ladle of producing cast steel to the specification below, giving the process. Steel castings, 36 to 40-ton tensile, with 6 to 10 per cent. elongation.

Carbon	0·35 to 0·45
Silicon	0·15 to 0·25
Sulphur	0·08 max.
Phosphorus	0·08 max.
Manganese	0·50 to 0·75

November 11th. J. W.

CONCRETE.

Sir,—The letters on concrete which you have recently published raise a most important point.

There is little doubt that in the majority of general engineering contracts neither the designers, contractors, nor supervisory staff have the time or specialised knowledge necessary to specify or produce really good concrete, with the result that the 1 : 2 : 4 mix with a generous factor of safety continues. This is both extravagant with material and uncertain in strength.

The remedy is for the designer to specify the strength he requires at any given age, together with freedom from chemical impurities liable to cause deterioration of the concrete or reinforcement, and to make sure that his requirements are carried out by frequent tests of sample cubes. Uniform results could then be relied on and the factor of safety safely reduced.

There is, in my opinion, a great opening for the supply of ready-mixed concrete of guaranteed strength, and suppliers of aggregate should, for this purpose, invest in a few travelling mixers and supply concrete instead. Their experts would be able to obtain maximum strength with minimum cement by the daily use of aggregate with whose fineness modulus and other characteristics they were well acquainted, whilst the men on the job itself would be freed from all worry about grading and water-cement ratio.

Concrete would undoubtedly be cheaper under these conditions, and would come into line with other materials, such as steel, which are usually supplied with a guaranteed strength and uniformity. With the removal of uncertainty we might expect the use of reinforced concrete to become even more universal than at present.

Bournemouth, November 9th. J. C. G. Mules.

SIXTY YEARS AGO.

The original "Monitor" of the United States Navy was a vessel which in a few stages of evolution might easily have developed into a submarine. She had no masts or funnel, her freeboard was but 18in., and when afloat in normal fighting trim she presented above the surface of the water little more than a circular turret 20ft. in diameter and containing two 11in. Dahlgren guns. She set a fashion in naval architecture, but the process of development in vessels of the monitor type took the design away from rather than towards the idea of the submarine. In this country a hot debate arose as to the merits of the type, and it was generally agreed that, while an American monitor had shown herself to be capable of crossing the Atlantic, the principal utility of the class lay in coast defence. By 1870 the British Navy possessed several monitors, the "Cerberus," the "Abyssinia," the "Magdala," and others. In our issue of November 17th, 1871, we described the "Glatton," the most recent monitor to complete her trials. Even in the short period which had elapsed since the original "Monitor" had appeared the design had undergone a notable change. The "Glatton" may have seemed to the sailors of the day more like a dredging machine than a warship, as one correspondent expressed it; but to modern eyes she appears much more like a normal surface vessel than the original "Monitor." There was no suggestion of the submarine about her. Her freeboard, it is true, was low, 3ft. normally, but capable of being reduced to 2ft. by flooding her water spaces. But in addition to her twin-gun turret she was equipped with a considerable upper structure, flying bridges, a funnel and a mast. She was very heavily armoured. Of her total tonnage of 2700, 500 tons of which were accounted for by her coal, her protective armouring represented 1100 tons. Above the water line her armour consisted for the most part of 12in. iron backed with 16in. of teak. A correspondent who had visited the ship during her trials drew a somewhat gloomy picture of the discomforts of her internal accommodation, although he had nothing but praise for her as a fighting machine. It was good-bye, he said, to the comfort and jollity of a sailor's life as depicted by Marryat. No longer, he feared, would the blue blood of England fight for berths in ships in which, below deck, they had to walk, like the heathen, in darkness, while, above deck, they had to stand, like the wicked, in slippery places exposed to wind and wave. Good-bye, too, might be said to rapid, adventurous voyages if our new war vessels were, like the "Glatton," to have a speed at the utmost of 9½ knots and were never to venture out of sight of shore. The monitor type of ship persisted in the navies of the world for a comparatively short time. It was, however, revived during the Great War, and several vessels of this class—including a second "Glatton"—were employed by the British Navy for the bombardment of the German posts on the Belgian coast.

S.A. ELECTRICITY EXTENSIONS.

The expansion in electrical undertakings in the country and the erection of new stations are about the only branches of industry, outside gold-mining, which are still active in the Union. An idea of recent progress is reflected in the Electricity Supply Commission's annual report recently published, which shows that during 1930 the electricity extension schemes of urban local authorities involved a total capital expenditure of over £750,000. Throughout the Union there is a total of 141 municipal electrical undertakings supplying ten towns, with populations varying from approximately 202,000 to 18,500, leaving the balance of 131 with populations from below 18,500 to as low as, or less than, 1000. No less than 52 small undertakings have been established during the past five years. The most important change to record is that of the conversion from direct current to alternating current. No less than twenty-four towns have changed over in the past few years. Also, since the Electricity Supply Commission has spread out its transmission lines from the few centres where it has established big power stations, quite a number of small plants have been closed down in favour of purchase in bulk. It is significant of the rapidity with which people are taking to electricity that quite a good proportion of these recently completed undertakings already require enlarging. In respect of big undertakings and their extensions, those of the Vereeniging Power Station of the Victoria Falls and Transvaal Power Company are well advanced. The two large turbo-generators, one of 32,500 kW at Vereeniging and one of 20,000 kW at Brakpan have been in commission since March last, and the new electrically-driven air compressor station at Canada Dam will start in the near future. The Canada Dam compressor station is to be interconnected with the company's other compressor plant at Rosherville and the Robinson compressor station by pipes of 27½in. diameter. To meet the growing demand a further extension programme is now in hand, comprising two large generating sets of 32,500 kW each, with boilers and boiler-house for them. To cope with the growing demand, which it is experiencing, the Pretoria Council has accepted the tender of C. A. Parsons and Co., Ltd., for a 12,500 turbo-alternator and condensing plant. It may be repeated also that Johannesburg will soon make a start on the extension programme, which will cost in the neighbourhood of £500,000, and even so the tale is not completed, but it will give an idea of the progress being made.

It has been decided that an automatic public telephone exchange, capable of dealing with 15,000 subscribers, shall be put up at Tucuman, Argentina.

Railway and Road Matters.

At the end of the forty-third week, the combined receipts of the four grouped railway companies were £12,325,000 less than in the corresponding period of 1930 and £20,430,000 less than that of 1929.

Some new milk tanks recently constructed by the Great Western are provided with a sheet-metal outer canopy, which allows for air space around the top of the tank, and so keeps the direct rays of the sun from the tank.

The Great Western Railway, possibly because it has no continental steamship services, has no Paris representative. It is, therefore, a gratifying sign of the times that occasion has been taken of the opening by the Southern Railway of new offices in that city for their joint use by both companies.

Hitherto there have been on the London, Midland and Scottish Railway two vice-presidents for traffic operating and commercial. For the present the position held by Mr. Quirey, now vacant for reasons given below, will not be filled, and Mr. J. H. Follows will perform the duties along with his own.

The National Union of Railwaymen has had two general secretaries—a political and an industrial. The retirement of Mr. J. H. Thomas from the former office has led to a special delegate meeting passing a resolution, to be submitted to the annual general meeting next July, that both offices be combined in that of general secretary.

To cater for passengers travelling by the special boat expresses from Plymouth to London, the Great Western has provided some special saloons which have three compartments. A large compartment, of the usual restaurant car type, seats seventeen, a smaller has accommodation for eight, and a coupé compartment for four. An extra charge is made for their use.

The figures as to accidents at level crossings published in Colonel Mount's annual accident report for 1930 lead him to remark that, having regard to the continued growth of road traffic, the statistics continue to justify the general conclusion that danger to the public using level crossings in this country is not increasing. Constant action is being taken to improve the protective arrangements where required.

The announcement is made that the railway constructed under the Downham and Stoke Ferry Act of 1879 is to be worked as a light railway under the London and North-Eastern (Downham and Stoke Ferry) Light Railway Order, 1931. This is a change that may be made under Sec. 18 of the Light Railways Act, 1896. The method of working is much more economical than on a standard railway, but the speed is very considerably limited.

Opinions differ as to what will be the fate of the London Transport Bill in the new Parliament. Anything that savours of public ownership or public control is now less likely to go forward, especially with a Bill that passed the Joint Select Committee stage by the casting vote of the Chairman. It is, on the other hand, significant that the *Evening Standard* of October 29th suggested that the order of legislation would be tariffs first, London Transport second, and then the reform of the House of Lords.

The 4.5 p.m. London and North-Eastern passenger train from Fort William to Glasgow on June 27th, had six four-wheeled fish vans behind the brake. All these were lightly laden, but the last of the six was particularly so, as it carried only 22 cwt. The line crosses Rannoch Moor between Corrour and Rannoch stations, a distance of 7 miles, and is single tracked. It falls generally, but at a point about 2¾ miles from Currour there commences a length of 600 yards that rises 1 in 83 up to a point known locally as "the summit"; thence it falls 1 in 86. There is a general speed restriction of 40 m.p.h. over the whole of the West Highland Railway north of Craizendoran. When about half-way between the two stations named, the leading pair of wheels of the last fish van left the rails and ran in that condition, unnoticed by the trainmen, to Rannoch Station, where the vehicle was wholly derailed at the loop facing points, and drew the fifth van off the road also. The accident was inquired into by Colonel Trench, who could not find a definite cause for the mishap. The track was in good condition, but there was some irregularity of curvature during the 70 yards prior to derailment. The timing allowed for the journey between the two points was hardly suitable to a general maximum speed of 40 m.p.h. It is probable that at the point of detailment it was 50 or 55 m.p.h. The combination therefore of an unusually light load, the vehicle being the last of six lightly loaded vans, the irregularity in curvature, an undue speed, and a possible sudden brake application, no doubt led to the accident.

Sec. 21 of the Ministry of Transport Act, 1919, which set up that Department, provided that for the purpose of giving advice to the Minister there should be a Rates Advisory Committee of five persons, one of whom was to be a representative of transportation interests. The person thus appointed was Mr. W. R. Jepson, formerly the mineral manager, but at that time parliamentary assistant to the general manager, London and North-Western Railway. Under Sec. 20 of the subsequent Railways Act, 1921, there was established a Court, styled the Railway Rates Tribunal. It had three members—one, the President, was to be an experienced lawyer; one was to be a person of experience in commercial affairs; and one was to be a person of experience in railway matters. The gentleman selected for the last office was Mr. Jepson, and the person of experience in commercial matters was Mr. G. C. Locket, who was a member of a firm of coal factors. The Rates Advisory Committee then came to an end. Both those gentlemen have now retired, to the regret of the Chairman—Sir Walter B. Clode—of the railways and of the trading interests. Mr. Locket is being succeeded by Mr. H. E. Parkes, and Mr. Jepson's successor is Mr. John Quirey, who began his railway career on the Belfast and Northern Counties Railway under the late Mr. Walter Bailey, and succeeded him when he went to the Midland Railway. Mr. Quirey also, in 1917, went to Derby, and in 1920 became the accountant to the Midland. On the formation of the L.M.S. Railway he was made joint accountant, and, later, accountant-general. Since 1927 he has been one of the vice-presidents of the L.M. and S. Railway.

Notes and Memoranda.

A writer in the *American Machinist* gives some hints as to the care of boots worn by the attendants on automatic machines on which large quantities of oil are used. The boots become soaked with oil and are very uncomfortable. He says that if the boots are kept overnight in a box of fuller's earth the oil will be drawn out of them, and that the earth can be used many times before it is necessary to renew it.

The use of lead tungstate as a paint-drying agent has been studied for the past year or two in the laboratories of the U.S. Paint and Varnish Research Association, and the conclusion has been arrived at that it holds out excellent promise, particularly for use in outside paint coats which are desired to dry very rapidly. The incorporation of lead tungstate in these coatings also gives them very good resistance to weathering.

The average life of cars in the United States is seven years. This means that the 4,034,012 cars built in 1923 should have been replaced in 1930; but because of the present state of depression many will probably be retained until next year. This means that 1932 should be a record year for replacements, provided there is a general recovery in purchasing power; the more so because two million less vehicles were produced in 1930 than in 1929. Another point of interest is that 1930 was the first year in the history of American motor cars when registrations of passenger cars did not increase. From 1895 to 1929 there had never been an increase of less than 5 per cent., but in 1930 there was a decrease of one-third of 1 per cent.

An instrument, known as the Blancometer, by which the degree of whiteness of an object can be measured or compared with some standard, has recently been put on the market. For the standard white surface, magnesium oxide deposited on greyed aluminimum is used, the former material giving the purest white known. Light is reflected into a photo-electric cell from the test surface, passing on its way through two fixed photometric wedges, while light from the standard white surface passes to the cell through two adjustable wedges. The latter enable equal deflections to be obtained in the two cases in an electrometer operating in conjunction with the photo-electric cell. A similar determination using two magnesium-oxide surfaces gives the zero position of the adjustable wedges. If, then, the gradation constant of the wedges be known, the ratio of the intensities of the reflected light from the test surface and the standard white surface can be found. Colour screens, isolating definite portions of the spectrum, can be inserted in the path of the light to enable readings to be obtained for red, green, and blue light.

Six permanent electric supply companies in the United States are associated in a trial installation for generating electricity by means of a wind rotor, similar in principle to that of Dr. Floettner's rotor ship which crossed the Atlantic some years ago. The plant is to be erected on a plot adjoining the West Burlington (N.J.) station of the Public Service Electric and Gas Company. It is proposed to erect between fifteen and forty 50-ton vertical rotors mounted on trucks which will circle around a 30ft. gauge track about 3000ft. in diameter. Each rotor will consist of an aluminium shell braced and supported by a duralumin framework. The rotating system is propelled by the wind around the track, each rotor driving a generator to which it is coupled. The generators are to be operated in parallel, and will supply their output through trolleys to an overhead line. To provide for continuous rotation it will be necessary to reverse the direction of rotation of each rotor twice during a complete circuit of the track. Each rotor unit is expected to be capable of producing 1000 kW under favourable wind velocities.

In the course of a lecture on hydrogenation, delivered to the Institution of Chemical Engineers, Dr. E. F. Armstrong explained that whenever pure hydrogen was required in localities where electric power was cheap, its production by the electrolysis of 18 to 20 per cent. caustic soda, or of 25 to 30 per cent. caustic potash, solutions was the method chosen. As the potash electroyte was the more costly and the diaphragms and insulators not so durable, it was usually preferable to use caustic soda. For small quantities, often under 3000 cubic feet per hour, electrolytic hydrogen was undoubtedly cheaper than that produced by any other method. Modern electroytic plant might be divided broadly into two types—filter press and collecting bell cells. The chief advantages claimed for the former were low first cost and the small floor space required, but it presented many difficulties in design. The bell type was represented by the well-known Knowles cell of the International Electric Plant Company, and this British concern held the field. An efficiency of 140 kWh per 1000 cubic feet, and a guaranteed purity of from 99·6 to 99·8 per cent. oxygen and from 99·8 to 100 per cent. hydrogen could be regularly obtained. A cell to pass a given current at 2 V would require three times the electrode area of one to pass the same current at 2·5 V.

A lecture on "The Navigation of Ships during Fog" was recently delivered to the Royal Scottish Society of Arts in Edinburgh, by Mr. D. Alan Stevenson, M. Inst. C.E. Air fog signals, he said, were increasing in number and power, but the disadvantage of this form of signal was the effect of wind, which retarded and elevated the sound waves, so that sometimes a powerful coastal signal could be heard at sea from a distance of only 1¼ miles against the wind. There was now nearing completion round the British shores a chain of 500-watt wireless beacons, and the advantages and objections were stated regarding this and other forms of wireless, such as the revolving reflector beam and the revolving loop. The leader cable and submarine signals were also referred to. The talking beacon, which had been an unqualified success since its establishment at Cumbrae Lighthouse, on the Clyde, was explained. Its operation showed that it combined the fullest advantages of all other forms of sea signals without any of the disadvantages of each. In speech and without calculation, it afforded distances to vessels, great and small, whenever they heard the fog signal through the air, and also gave direction of wireless at low cost to both lighthouse authority and to ship. It changed a fog signal into an instrument of precision.

Miscellanea.

The largest party ever to take the air together was carried by the airship "Akron" on November 3rd, when she left the aerodrome at Lake Hurst, New Jersey, with 207 persons on board.

The mapping of 11,000 square miles of the Upper Nile Valley has just been completed by two Fairey-Napier aeroplanes at a saving of £60,000 and years of work as compared with the ordinary methods.

The new equipment for shipping China clay at St. Austell, Cornwall, which has cost some £40,000, has just been put in service. It is anticipated that the plant will greatly expedite the shipment of the clay.

The outgoing international calls on the telephone from this country in June numbered 51,431, and the incoming calls 55,463. The increases over the corresponding month of last year were of the order of 16 to 17 per cent.

The ship lift on the Hohenzollern Canal, between the rivers Oder and Spree, is to be capable of handling vessels of 1000 tons. The lift itself weighs some 3200 tons and a transfer from one level to the other of 110ft. will be effected in five minutes, with the aid of four electric motors of 75 horse-power each.

At the annual general meeting of the British Steelwork Association, held at Caxton House, Westminster, on November 4th, Mr. J. H. Humphryes (Braithwaite and Co., Engineers, Ltd.) was elected President for the year 1931–32, and Mr. Ben Walmsley, C.B.E. (Dorman, Long and Co., Ltd.) was elected Vice-president.

The big non-rigid dirigible, the U.S. Navy's "K 1," was wrecked at Cape May, New Jersey, on November 3rd. She was being manœuvred into her hangar when her 220ft. gasbag was caught by a gust of wind. Though the ground party exerted all their strength to keep control of her, she was carried against a barbed wire fence, where her fabric was torn to pieces. Her crew of five was not on board.

On Tuesday last the submarine "Swordfish" was launched at Chatham Dockyard, and was named by Lady Tyrwhitt, wife of Admiral Sir Reginald Tyrwhitt, Commander-in-Chief at the Nore. This is the first of the three submarines authorised in the 1929 Navy Estimates to be put afloat. The others are the "Sturgeon," under construction at Chatham, and the "Thames," being built by Vickers-Armstrongs, Ltd., at Barrow.

The bascules of the Tower Bridge were raised 5346 times last year for the passage of vessels. The highest number of lifts in one day was thirty-one and the lowest two. Land traffic was suspended on the average 4·21 min. for vessels to pass. The maximum period was 23½ min. and the minimum 1½ min. Since the opening of the bridge the bascules have been raised 244,218 times, and there have been no delays due to defects in the machinery.

A few days ago Alderman C. M. Morton, Chairman of the Quay Committee of the Gateshead Corporation, opened the new quay at Gateshead, which has been leased by the Tyne Tees Shipping Company, Ltd., for its continental trade. The quay replaces that which collapsed in 1929, and extends to a length of 442ft. The berths give 18ft. at low water and 33ft. at high water. Sir Arthur Sutherland, presiding over a luncheon given by the company, said that if things went well they might add to their facilities as they had acquired the land to east and west of the new quay.

The National Federation of Iron and Steel Manufacturers reports that the number of furnaces in operation at the end of October rose to sixty-six, four furnaces having been blown in during the month. The production of pig iron amounted to 284,200 tons, compared with 248,200 tons in September and 415,000 tons in October, 1930. The production included 53,300 tons of hematite, 118,000 tons of basic, 94,100 tons of foundry, and 12,900 tons of forge pig iron. The October output of steel ingots and castings amounted to 457,400 tons, compared with 400,500 tons in September, and 512,500 tons in October, 1930.

On Thursday evening, November 5th, Sir William Davy, Chairman of the Manchester Airport Committee, inaugurated the aerial beacon on the roof of Ryland's building in Market-street. The pillar of light, which he switched on by pressing a button in the main hall of the building, is of 20,000 candle-power, and has been officially recognised by the Air Ministry as an "air sign-post." It will shine nightly between sunset and sunrise, and when conditions are normal its rays are expected to be visible for 60 miles. A number of distinguished airmen were present at the opening ceremony, and a dinner in celebration of the inauguration was held afterwards in the Queen's Hotel.

Good contracts may come to England as the result of a decision of the Danish State Railway to electrify on the "overhead" system some of the suburban lines around Copenhagen; 27 miles of track are to be converted. Tenders are now being invited for the first 15 miles; the other 12 miles will be taken in hand later. The Danish Legation announces that it has been instructed to show British electrical and railway manufacturing firms the plans, with a view to the submission of tenders. Continental firms are likely to be keen competitors. The tenders required are for the provision of overhead cables, general overhead equipment, including masts to support the wires, switchgear, and other material. All have to be delivered and installed.

With the object of providing an express air mail service between London and Cape Town, Imperial Airways have placed an order with Armstrong Whitworth Aircraft, Ltd., of Coventry, for a fleet of eight great 145 miles an hour four-engined monoplane air liners. The new machines, which will be the largest monoplane air liners ever built in Britain, have been specially designed to operate in the particular climatic and geographical conditions encountered on the 8000 miles flight between London and Cape Town. Special attention has been directed to the comfort of passengers flying in tropical conditions, and greater space per passenger has been allowed than in any previous passenger aeroplane. Ice chests will be fitted to each machine to provide iced drinks and cool food.

SOME ROAD ROLLERS AT THE PUBLIC WORKS EXHIBITION

(For description see page 511)

FIG. 13—LIGHT OIL ENGINE-DRIVEN ROLLER—RUSTON AND HORNSBY

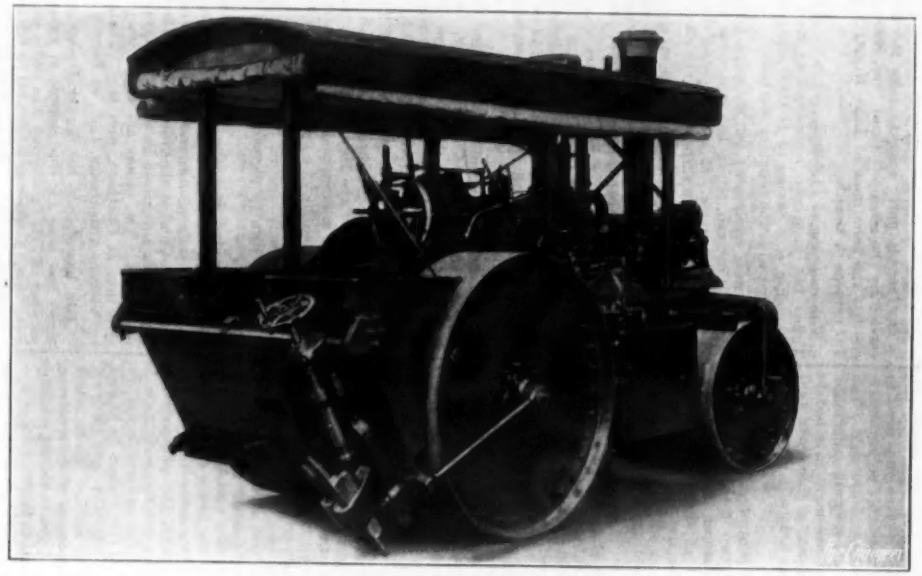

FIG. 14—STEAM ROAD ROLLER—MARSHALL

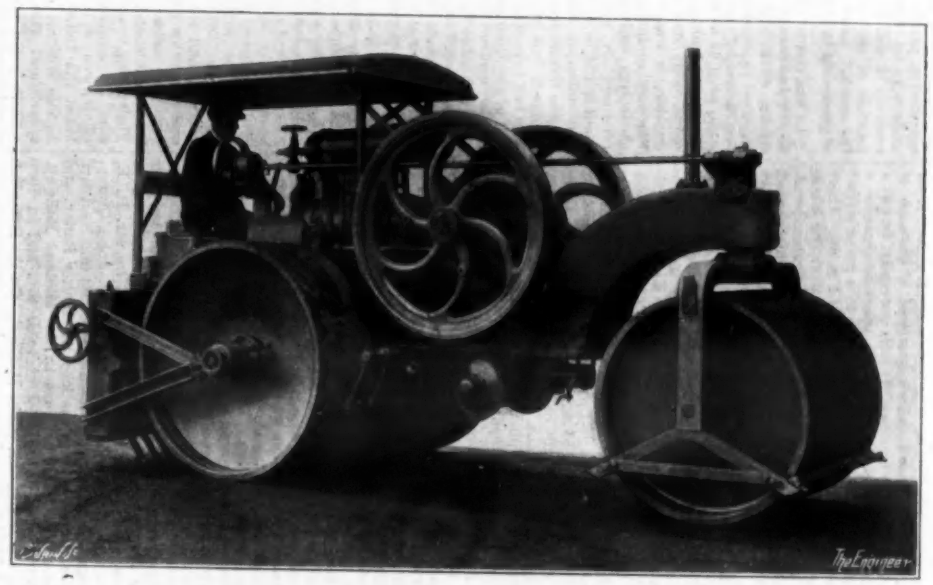

FIG. 15—14-TON OIL ENGINE-DRIVEN ROLLER—AVELING AND PORTER

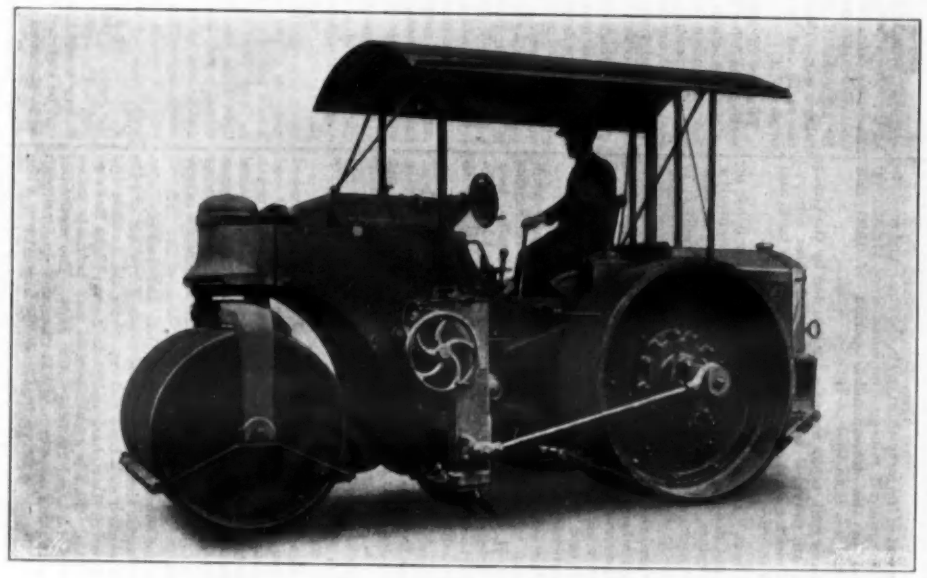

FIG. 16—8-TON MOTOR ROLLER—BARFORD AND PERKINS

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THE ENGINEER.

VOL. CLII. No. 3957

NOVEMBER 13, 1931.

Confidence.

CONVERSATIONS with many industrial engineers since the Election have confirmed the optimism which is shown by the trade correspondents of this and other newspapers. There is, beyond all question, an improvement in the manufacturing atmosphere. Very cautious people, balancing themselves skilfully between "It is" and "It is not," protest that the glimpse of a silver lining is no more than a reflection of the passing of the gold standard. They hold themselves in readiness to say "I told you so" if the present revival fails as its predecessors did. But, on the whole, there is a general belief that the "slump" is dispersing and that brighter years are in front of all British industries. It is noteworthy that, without exception, all those who feel the buoyancy give the reason in the same one word—"Confidence." The many months of uncertainty, doubt and anxiety which began with the return of the Socialist Government in the spring of 1929 have come to an end. The country has shown in a quite unmistakable way that it wants repose, stability and moderate rule. It is in no mind to pursue a policy which has disturbed the ancient fabric of its prosperity and is nearly akin to methods which have brought down great and adjacent communities. Of all countries in the world it may be said that none knows better than Great Britain how to effect great advances, how to improve social conditions, and how to remove abuses, without complete disorganisation of the social system. Once in our history we had a great Revolution. It brought civil war in its train and a revulsion almost as devastating as the war. But we learnt our lesson from Cromwell and the Stuarts. Parliament was established on a sure basis, the representation of the people was made complete, and all occasion for the repetition of those tragic years was once and for all removed. Later, a revolution of a different kind took place. The sudden coming of the factory system, combined with the rapid development of mining, threw the country off its balance and caused it, for a period, to tolerate a degradation of the workers that a later generation recognised as detestable. But the removal of the evils was brought about by Parliament through a series of Acts, the spirit of which has remained to the present day and is firmly ingrained in the social organisation of the country. Partly through those Acts, but more largely, perhaps, through the mentality which they engendered, labour reform has ever since proceeded steadily, sometimes by the order of Parliament, but more often by the voluntary action of employers. Hence, it has come about that to the fourteen or fifteen million workers of the Kingdom all is given that it is possible at the time for the industries to afford. It was because the Socialists deliberately ignored that fact, because they endeavoured to take from industry more than it could spare and still remain in health, that the country was brought to the edge of disaster. It is because that wild and dangerous policy is to be replaced by one which will ensure that we do not spend beyond our means and that we strive to recover, and to recover quickly, from the sad pass to which wild principles have brought us, that a new feeling of confidence is permeating all manufactures and commerce and giving new hope for Great Britain, the Empire, and the World.

In his Guildhall speech on Monday last, Mr. MacDonald said: "The condition of the world is such as to call for the Statesmen of all nations to come boldly together as severely practical men and find some sound foundation upon which the future of the world may be built up." If it were ever prudent for an industrial nation to stand alone, that time has now passed for ever. The conquest of local difficulties, the extension of mechanical means of production, the diffusion of science and technical knowledge, and the growth of means of communication, have deprived every country of the world of the particular advantages which it enjoyed by reason of natural and acquired characteristics. In the field of manufactures it may be said that what one nation can do any other can. The world is now composed of a community of nations with common interests. If one member of that community suffers, all suffer. It must therefore be the concern of all to see that all are prosperous. That is a new truth which even now is not fully recognised. Something of the old antagonism to foreign nations still remains; some envy and jealousy of their success is still expressed. Great statesmanship will be needed to remove that feeling; still greater to bring all nations into harmony for the common good. Mr. MacDonald is right in placing the attempt amongst the great objects of the National Government. Thinking men have been puzzled during the period of the depression by the fact that whilst there is more than enough capacity for the manufacture of all that men can desire, and that the will to possess is made stronger daily by the artifices of the salesmen, yet industries have been at a standstill. One cause and another has been advanced to explain this anomaly. To each exponent his own arguments have appeared conclusive, but they have not convinced the others. Some have blamed the banks, some the capitalists, some labour, some middle-men, some tariff walls, some employers, some even Progress itself. Amongst these diverse views a course must be sought. It is not impossible that all are right in some degree, and it is probable that international agreements may go far to remove the major difficulties, whilst national actions diminish the remainder. In any case, it is beyond all question that the world can absorb far more of the products of its factories than it has done during the few lean years which we trust are now coming to an end. We have before us the remarkable case of the United States. A couple of years ago they were enjoying unexampled prosperity; there was no unemployment, there was little poverty, the people bought and sold freely, they found new wants and the means of satisfying them. Why was there a sudden change from that happy condition? There was no lack of money, there was no disastrous harvest, there was no war, there was no pestilence. With no outwardly apparent cause the tide of prosperity turned and ebbed with unparalleled speed, until America found herself brought down from the prosperity of which she had boasted to but little above the level of the European countries before which she had been held up as an example. From that picture we cannot turn our eyes. If America needed all that she could produce in 1928, can we bring ourselves to believe that in 1930 she had not equal powers of consumption? No; it is clear that some power over which control has, for the moment, been lost has operated to effect that change.

We do not propose to discuss whether or not America brought the trouble upon herself, but we cannot escape the conviction that it was associated with the European depression and that it affords, on the one hand, a striking example of the necessity of the international statesmanship to which Mr. MacDonald alluded, and, on the other, gives us reason to believe that the ability of the world to absorb manufactures is only in abeyance.

We do not hesitate to say that amongst the causes of the world depression the late policy of Great Britain had much weight. The return of confidence is due to the fact that by an enormous majority the country has shown its desire for a rapid replacement of that policy by one which will help to build up industries instead of destroy them, and encourage commerce instead of envying it. We are confident that the anti-capitalist theories of the late Parliament will find no place in the new. We anticipate that whatever is proved to be good for industry will be encouraged, even if it should bring great wealth to a few. The effect of Socialism upon industry and commerce has been shown to be bad. It has even been proved to fail in its major purpose, for it is impossible to deny that a period of great distress and privation was narrowly averted by the dissolution of the Labour Government. The principles which swayed that Government are gone, we believe, for many years. The country has accepted with relief the promise of a return to more sober ways, and is showing by a feeling of buoyancy its belief that before many months have passed the change will be followed by a resuscitation of prosperity. It may well be that the improvement of Great Britain will be both cause and herald of a general world improvement, and that Germany and America, Austria and Holland, Norway and Sweden, Belgium, Italy and France will share with us in the prosperity which we are confident is foreshadowed, though yet some distance off, by the new spirit which is stirring in industry and commerce.

Coil Ignition.

More than eleven years ago, when magneto construction was attracting considerable attention in this country, we expressed the opinion that in all probability coil ignition would eventually be widely employed on British-made motor cars. With the rapidly growing use of electric starters, &c., and the consequent provision of a charging dynamo, coil ignition seemed inevitable, in spite of its unsatisfactory behaviour in the past. Many an early motorist has reasons to remember the shortcomings of the coil system, when the battery could not be charged *en route*; many things that were said about it have never appeared in print. But troubles are soon forgotten when once they have been removed, and those who would reject a car because it was not fitted with a magneto probably form now a very small proportion of the motoring public. Since 1921, states Mr. E. A. Watson, in a paper on "Coil Ignition Systems," read on November 5th before the Institution of Electrical Engineers—a day, by the way, on which much ignition occurs—the coil or battery system has made considerable headway, both in this country and on the Continent, and is fitted to at least 80 per cent. of the motor cars now being produced. The chief reasons for the change are the lower cost of the coil system for multi-cylinder engines; the avoidance of the difficult problems involved in driving a magneto, and the choice of a suitable type for high-speed engines with six or more cylinders. Coil ignition in its present stage of evolution represents the result of much investigation, as well as designing skill. The trembler coil is completely obsolete. The system generally employed now has a contact-breaker driven positively by the power unit at a speed, in the case of a four-stroke engine, of half engine speed, and the interrupted current in the primary winding of the coil induces a high secondary voltage, which is supplied through a synchronously driven distributor to the sparking plugs of the engine. But simple as the design of an ignition system of this kind would appear to be, Mr. Watson's paper shows that the job is not quite so straightforward as it looks.

The general problem in any coil system resolves itself into obtaining a value of the interrupted current sufficient to ensure satisfactory ignition without an excessive current at low speeds and without involving risk of overheating in the event of the ignition circuit being left closed when the engine is at rest. Here, however, we cannot do more than say that the author describes a simplified treatment of the induction coil regarded as a closely coupled system with damping due to secondary loading, and from this theory he develops a basis of coil design, enabling optimum values to be chosen so as to meet given conditions. He also indicates the limits that are met with under extreme conditions of operation, generally at high engine speeds and low battery voltages, and describes special designs that have been developed with a view to meeting those conditions. From a manufacturing point of view the main value of the paper lies towards the end, where the author describes the constructional features of modern coil systems and the principal points of the various details. Perhaps it may come as a surprise to some car owners to know that the original ignition coil has been turned inside out; in other words, the secondary coil is now wound next to the core, whilst the primary coil surrounds it. The mean high-tension turn is therefore comparatively short, and the weight of wire used is less than when this winding is arranged externally. Without involving undue expense, it thus becomes possible to employ a greater number of secondary turns, and relatively large primary inductance can be obtained in virtue of turns rather than in virtue of flux, with a consequent reduction in iron loss and damping. As, moreover, the primary winding is outside, use can be made of a metal case which readily dissipates the heat and affords good protection. Still another advantage of the design is that the self-capacitance of the coil is usually less than that of the older pattern. The design of the contact-breaker and distributor, which are practically always combined in a common unit generally termed the "distributor head," or the "distributor," is a matter to which the author pays considerable attention, for upon the satisfactory performance of the contact-breaker in particular the proper working of the system largely depends. One of the ignition systems described for meeting special conditions differs radically from the orthodox system. The principle involved is that of charging a condenser to an appropriate voltage and connecting it periodically by means of a contact-maker to the primary winding of a transformer, which takes the place of the coil. If the coupling of the transformer is perfect, the spark occurs immediately the circuit is closed; the rise of voltage is instantaneous and secondary loading has no effect on the performance. But although the system is simple, it necessitates the provision of a pressure of about 200 volts. Lower voltages are unsatisfactory, because they necessitate large storage condensers, and the current to be handled by the contact-maker is excessive. In most cases the high voltage makes the system unsuitable for cars, although it is considered that it may meet with application under special conditions.

Perhaps some who have seen Mr. Watson's paper have been surprised to find that the design of ignition coils has been reduced to such a fine art. Originally, these coils were small examples of those employed in technical schools and elsewhere, and were constructed without any very special regard to the conditions to be met. With the lack of designing knowledge and the unreliability of the current supply, it is scarcely to be wondered at that in the early days of motoring coil ignition gave trouble. But, like many other electrical devices which were at one time unsatisfactory, the ignition coil has now received the attention of technical men who have studied its imperfections and have made it work as it should. If the conditions of working become more onerous, the modified systems mentioned in the paper will no doubt be developed to meet them, and it is equally certain that small points conducive to cheapness in the construction of standard equipment will continue to claim the attention of manufacturers.

The Tidal Thames.*

No. II.†

Fresh-water Flow.

The total natural flow of the river at Teddington, which includes the water abstracted by the Water Board and companies, was for the year 1930, 623,184 million gallons, giving a natural average flow of about 1707 million gallons per day. The drainage area of the Thames Basin above Teddington is 2,423,000 acres, so that the natural average flow is equal to 707 gallons per day per acre of drainage area, or, if expressed in inches of rainfall, amounts to 11·37in. out of a total average rainfall for the year of 30·12in. The natural run-off for that year was therefore equal to 37·79 per cent. Subtracting the water taken by the Water Board and companies—66,327 million gallons—the run-off is reduced to 630 gallons per day per acre or 10·13in. of rainfall, which gives a run-off of 33·65 per cent.

The average annual natural flow of the river at Teddington for the period of twenty-six years from April 1st, 1904, to March 31st, 1930, was 579,577½ million gallons, or 655 gallons per day per acre of drainage area. Taking the average annual rainfall at 30·26in., which was the average over the same period, the run-off was equal to 39·70 per cent., as against the natural run-off of 37·79 per cent. for the year 1930. The ordinary maximum natural flow at Teddington may be taken at 10,500 million gallons per day, which is 6·616 times the natural average daily flow, but the exceptional natural flow of 20,236½ million gallons at Teddington on November 18th 1894, is equal to 12¾ times the natural average daily flow.

Docks.

The most important of the engineering works constructed in the Thames for the improvement of its facilities are the wet docks, and it is worth recording that the building of the first wet dock for commercial purposes was in great measure due to the desperate system of marauding and plunder that took place in the river when vessels were obliged to unload in the stream into lighters or alongside wharves.

In response to a petition to Parliament, a Committee of the House of Commons was appointed in 1796, with Sir William Young, Bart., as Chairman, to inquire into the best method of providing accommodation for the increased trade and shipping of the Port of London. A mass of evidence was placed before the Committee, including the submission of eight different plans for dealing with the shipping and trade of the port. As a result of this inquiry the Act of 1799 was passed, entitled "An Act for rendering more commodious and for better regulating the Port of London," generally known as the Wet Dock Act.

Under the powers of this Act the West India Dock Company built the Import Dock and Export Dock in the Isle of Dogs, and by a subsequent Act purchased the City Canal across the Isle of Dogs from the Corporation of London and formed it into the South Dock.

Many other docks were constructed from time to time, and a very comprehensive survey of these and of the several companies is given by Sir Joseph G. Broodbank in his "History of the Port of London," published in 1921. From the "appointed day," which was defined by the Act of 1908 as being March 31st, 1909, the St. Katherine, London, West India, Millwall, East India, Royal Victoria, Royal Albert, and Tilbury docks on the north side of the river, and the Surrey Commercial Docks on the south side, came under the jurisdiction of the Port Authority. At the date of the transfer the area of dock water was about 641¼ acres, and the length of quays about 27¼ miles.

In the period of about twenty-two years since the date of transfer the Port Authority have greatly improved and added to the docks, the most noteworthy additions being the construction of the King George V. Dock, and a new entrance lock and passenger landing-stage at Tilbury, for which works Sir Frederick Palmer, past-President, Inst. C.E., has been mainly responsible. The area of dock water has been increased to about 723 acres, and the length of quays to about 33 miles. The total capital expenditure incurred by the Authority on new works is over 14 million pounds.

The total net register tonnage of vessels entering and leaving the port has increased from 38½ millions in 1909 to 57½ millions for the year 1930.

Bridges.

The first historical reference to a bridge at London is in the year 994. This bridge was constructed of timber and replaced a ferry. Reference is again made to it in 1016, when Canute is said to have passed the bridge with his vessels by cutting a trench through the causeway on the south side for the siege of London.

The first stone bridge was begun in 1176 and completed in 1209, a constructional period of thirty-three years. Its demolition was commenced on November 22nd, 1831, so that it had remained for a period of 622 years, and its removal was finally completed in 1834. The question of its demolition was not, however, allowed to pass without severe opposition. It had been in existence for upwards of six centuries, and had become a relic very dear to the hearts of the citizens of London, and much water had passed under it between the times when the question of its demolition was first raised and finally decided.

It was stated by Mr. Labelye, a native of Switzerland, in a report laid before the Bridge House Committee of the Corporation on September 17th, 1746, that the bridge, like most of the stone bridges that were built about the same time over large and deep rivers, was founded on the tops of wooden piles cut off some feet above low-water mark, which become exposed to the air and decay, necessitating starlings to prevent them from ruin.

The removal of Old London Bridge had an immediate effect in deepening the river bed, and the attendant results were the failure of the foundations

* The Institution of Civil Engineers. Presidential address, delivered by Sir Cyril Reginald Sutton Kirkpatrick, November 3rd, 1931.—Abridged.

† No. I. appeared November 6th.

of Mylne's bridge at Blackfriars in 1836, and the quickly following failure of Labelye's Old Westminster Bridge. At Blackfriars, ten years after Old London Bridge had been removed, the river bed was 6ft. lower. The removal of the bridge, however, although the main cause, was not the sole cause of the altered condition of the bed of the river; contributory causes were the removal of Old Blackfriars and Westminster bridges and the dredging away of the shoals in the river below, particularly the extensive shoal which had grown at Dagenham in Halfway Reach.

The first waterworks were also erected at London Bridge in 1582 by Peter Morris, a Dutchman, for the purpose of supplying the City with water, and six years afterwards three other water wheels were erected at the Southwark end of the bridge for grinding corn; all of these were operated by the tides.

Old Blackfriars Bridge was built by the City Corporation to provide a new entrance into the centre of the Metropolis. In fixing the position of the bridge two objects were held to be desirable, namely, that its line across the river should be at right angles to the ebb and flood streams, and that the design should be in conformity with the interests of the navigation. The bridge was commenced on October 31st, 1760, from the design of Mr. Robert Mylne, and was completed in 1770, but it had to be replaced owing to the failure of the foundations after the demolition of Old London Bridge, and the present bridge of five iron arches resting on granite piers, from the design of Mr. Thomas Page, was opened in 1869, and was widened between 1907 and 1909 by the late Sir Benjamin Baker, K.C.B., and Sir Basil Mott, Bart., Past-Presidents Inst. C.E.

Old Westminster Bridge was authorised in 1735, and in 1736 a further Act was passed authorising its construction either across the river from New Palace Yard or from the Horse Ferry, which, from the earliest times, had connected Westminster with the opposite shore. It was finally decided to construct it from New Palace Yard, from the design of Mr. Charles Labelye. The first stone was laid on January 29th, 1739. It was the first bridge built on the Thames where caissons were used for laying the foundations on the gravel, the depths being not less than 5ft. nor more than 14ft. below the bed of the river.

Waterloo Bridge was authorised in 1809 as Strand Bridge, and its present name was only given to it in 1816 after the battle of Waterloo. Mr. John Rennie was appointed engineer for the work, and the first stone was laid on October 11th, 1811. This was the first bridge to be built on the Thames where cofferdams were used for laying the foundations. The bridge was opened on June 18th, 1817. In 1882 it was discovered that the foundations of the bridge were being exposed by the scour of the river, necessitating remedial measures, which were completed in 1884. The recent history of further settlements in some of the piers of this bridge is well known to all, and the remedial measures have still to be decided upon.

It is, in my opinion, well within the competence of civil engineers of to-day to design a more imposing and permanent structure for the purpose of replacing the old bridge, and the adoption of a 50 per cent. increase in the length of the spans would facilitate the navigation of the river and restrict in a less degree the flood and ebb streams.

Of the many other road and railway bridges across the tidal Thames below Teddington, note may in particular be made of the Tower Bridge, built from the design of the late Sir John Wolfe Barry, K.C.B., Past-President Inst. C.E., and completed in 1894; and Southwark Bridge, a three-arch cast iron bridge, completed in 1819 from the designs of Mr. Rennie, and reconstructed before and after the war as a five-span structure.

Tunnels.

It occurred to Sir Marc Isambard Brunel, a native of France, early in the nineteenth century to effect the crossing of the river by tunnel, but before this tunnel was commenced, and as early as the year 1798, Mr. Ralph Dodd had proposed a cylindrical tunnel 16ft. in diameter from Gravesend to Tilbury, at an estimated cost of £15,995. The work was commenced by the sinking of a shaft at Gravesend, which absorbed all the money raised, and as further financial aid was not forthcoming, the work was abandoned.

Another was projected by Mr. Vazie in 1802 from Rotherhithe to Limehouse, but after an expenditure of £7000 on the sinking of a shaft 11ft. in diameter to a depth of 42ft. the work was suspended until further funds were available. Eventually Vazie succeeded, by means of a caisson, in completing the shaft through the gravel to a depth of 76ft. below high water. The work of driving a heading about 14ft. in sectional area was then taken over by Mr. Trevithick, but the water broke in and flooded the heading on four occasions, the last and most serious being in 1807, when the work had been advanced to a length of 1118ft. The face of the heading was then timbered and the work abandoned.

After this event a company was formed in 1823 to carry out the Thames Tunnel project of Sir Isambard Brunel. A Bill incorporating the company received the Royal Assent on June 25th, 1824, and the work of driving a shaft contiguous to Cow-court, Rotherhithe, and at a distance of 141ft. from the river, was commenced on February 16th, 1825. The shaft, 50ft. in diameter, was sunk to the required depth of 62½ft. below high water on June 6th, and the work of boring the tunnel by the aid of a shield which Brunel had invented was commenced on November 28th. It is reported that in the previous week, owing to excitement, he was laid up with an illness "so serious as to demand very active treatment and the application of many leaches to his head."

Water broke into the tunnel almost from the commencement, and became more and more difficult to deal with as the tunnel advanced. On April 21st, 1827, at a distance of about 540ft., stones, brickbats, pieces of coal, bones and fragments of glass and china came down into the frames. An examination of the river bed, which was made by means of a diving-bell, revealed a considerable depression, and the ground proved so loose that an iron rod could be pushed down into the frames. . . . By June 11th, 19,500 cubic feet of clay and gravel had been dumped in the hole, and by November 10th the tunnel had been sufficiently restored for the resumption of work. The water broke in again on January 12th, 1828, and drowned two of the miners. As the funds of the company had become exhausted, it was decided in July, 1828, to block up the frames and stop the work, pending an appeal to be made to the country for the means necessary to complete the undertaking. In 1835 money was advanced by the Government and a shield was constructed by Messrs. Rennie. This was fixed in March, 1836, and the work was resumed, and, except for one delay of six weeks due to another flooding, the tunnel was driven without any further serious interruption until its completion in 1842.

Other tunnels under the river followed, namely, the Tower subway from Tower-hill to Tooley-street, constructed in 1869. It is an iron tube 7ft. in diameter and reached by shafts 60ft. in depth at each end, and was intended for passengers who were to be drawn backwards and forwards in a small carriage on rails. This, however, was found unremunerative and the rails were taken up. A platform was afterwards laid in the bottom of the tunnel for its use as a footway, but it is now used to carry water mains belonging to the Metropolitan Water Board. Blackwall Tunnel was opened to the public on May 2nd, 1897, and Rotherhithe Tunnel followed on June 12th, 1908. No other roadway tunnels have yet been constructed, but parliamentary powers have been obtained for a new tunnel from Purfleet to Dartford. The commencement of this work has unfortunately had to be suspended on account of the present financial stringency. Footway tunnels were constructed at Greenwich and Woolwich, and there are, of course, many other tunnels under the river, constructed for the tube railways and the Metropolitan Water Board.

Weirs.

The only weir on the tidal portion of the Thames is at Richmond, the crest of the sluices being 5ft. 9in. below Trinity High Water, or about 8ft. 9in. below the present level of high water of ordinary spring tides. In connection with the weir is a lock and boat-rollers, and a footbridge across the river. The works were constructed in 1894.

Another weir or barrage to be placed across the river between Tilbury and Gravesend was put forward by a committee formed in 1903 under the title of the Thames Barrage Committee, with Sir Thomas Brooke-Hitching as chairman, "to convert the whole of the lower river into a freshwater lake." Three Bills were promoted in Parliament to draw the attention of the authorities and river interests to the need for an inquiry into the claims put forward for the barrage. Such an inquiry was favoured by the Thames Conservancy, the City Corporation, the riverside boroughs, and others. The proposals included a roadway over the barrage, with tunnels for road and rail traffic in the foundations. Six locks of different dimensions were proposed, the sills being placed 55ft. below T.H.W. to give a minimum depth of 35ft. at L.W.O.S.T. Between the locks and the shore there were to be a series of sluices sixty in number, each having a width of 15ft., of which six were to be constructed in the base of the dam and operated when necessary for scouring the bed of the the river below, in order to keep open the approaches to the locks.

In my opinion it is a fortunate thing for London that this scheme was not approved, for the supremacy of London as a port with its approaches from the sea is due to the tidal scour, which should not be impeded.

Riverside Industries.

A few words may be devoted to some of the principal industries which have been or are now a feature of the busy banks of the Thames. Shipbuilding has practically disappeared, but for three or four centuries the banks of the Thames had two naval dockyards. one of these, that at Woolwich, was in its day the chief Royal Dockyard. Henry VII's "Regent" was built at Rotherhithe and Henry VIII's "Harry Grace à Dieu" was built in the dockyard. The East India Company established a dockyard at Deptford in 1609 for the construction of its celebrated ships. The river had a share in the building of the fast sea clippers; the "Challenger," which out-sailed the American "Challenge" on the race home from China, was laid down at Blackwall in 1850.

The substitution of iron for wood in shipbuilding and the introduction of steam propulsion marked the beginning of the decline of the Thames as a shipbuilding centre. Yet, before its shipbuilding glory departed the firms on the Thames had made some notable contributions to shipbuilding and marine engineering. Among the vessels may be mentioned the first steam vessel "Comet," the first iron screw steamer "Dwarf" (ex "Mermaid"), the first steamship of war "Trident," the first British ironclad floating battery "Thunderbolt," and the first ironclad steam frigate "Warrior." On its banks Joshua Field constructed the engines for the "Great Western," and at Millwall in 1859 was launched the "Great Eastern." The last great ship to be built on the Thames was the battleship "Thunderer," the keel of which was laid by the Thames Ironworks at Canning Town in 1910, and with her completion Thames shipbuilding became a negligible quantity.

Another of the principal industries on the banks of the Thames is the production of coal gas for fuel and lighting. At the present time about 4½ million tons of coal are carbonised annually at the riverside gasworks for the production of gas which is distributed by upwards of 7000 miles of mains. This coal is brought up the river by the companies' own steamers to their own wharves, and the by-products amount to over 1 million tons a year.

Another very important industry established on the banks of the Thames is the generation of electricity for lighting and power. The first Electric Lighting Act was passed in 1882. At the twelve riverside stations between Barking and Hammersmith 2,119,240,314 units were generated during the year ended December 31st, 1930, and the quantity of coal consumed for this purpose was 1,575,686 tons. It is estimated that the quantity of circulating water used for condensing is about 70 gallons per unit generated, so that over 650 million tons of water have to be borrowed from the river annually for that purpose. It is expected that in the year 1935 the number of units will have increased to 3500 million, the consumption of coal to 2,200,000 tons, and the water required to more than 1000 million tons.

A very important commercial undertaking is now being developed by the Ford Motor Company at Dagehnam, on the banks of the Thames, where the manufacture of 100,000 cars per annum will shortly be in progress. Perhaps the most striking innovation in connection with these works is the construction of the first blast-furnace on the Thames.

Extensive depôts for crude petroleum, motor spirit and lamp oil are established at Thames Haven in Sea Reach. Over 3 million tons were imported during the year 1930.

The tidal portion of the Thames forms the highway of the Port of London from the sea to the Metropolis, and the continued commercial supremacy of London is dependent on the river. I will conclude my address with the motto of the Port of London Authority—

Floreat Imperii Portus.

BOOKS RECEIVED.

First Ideas in the Calculus. By L. Crosland, M.C., B.Sc. London: Ginn and Co., Ltd., 7, Queen-square, W.C. 1. Price 2s. 6d. net.

The Journal of the Iron and Steel Institute. Vol. CXXII. Edited by G. C. Lloyd. London: The Iron and Steel Institute, 28, Victoria-street, S.W. 1.

Les Machines à courants continus. By R. Langlois-Berthelot. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins, France. Price 75f.

Stainless Iron and Steel. Second edition. By J. H. G. Monypenny. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

Warning Agents for Fuel Gases. Monograph 4 of the Bureau of Mines. New York: The American Gas Association, 420, Lexington-avenue, N.Y., U.S.A.

Transactions of the Institution of Chemical Engineers. Vol. 8, 1930. London: The Institution of Chemical Engineers, Abbey House, Westminster, S.W. 1.

Welding of Structures. By A. V. Prince. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

Michael Faraday and Some of his Contemporaries. By Wm. Cramp. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 2s. 6d. net.

A Dictionary of Electrical Terms. Second edition. By S. R. Roget. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 7s. 6d. net.

Transactions of the Institution of Naval Architects. Vol. LXXIII. Edited by R. W. Dana. London: The Institution of Naval Architects, 2, Adam-street, W.C. 2.

The National Federation of Iron and Steel Manufacturers: First Report of the Corrosion Committee to the Iron and Steel Industrial Research Council. London: The Iron and Steel Institute, 28, Victoria-street, S.W. 1.

Light Spirits from the Low-temperature Carbonisation of Coal. Fuel Research Technical Paper No. 34. By D. Hicks, M.Sc., and J. G. King, Ph.D., &c. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6d. net.

Congrès International des Mines, de la Métallurgie et de la Géologie appliquée. VIme Session. Liége, 22–28 Juin, 1930. Section de Géologie; Section de Métallurgie; Section des Mines. Liége: Congrès International des Mines, de la Métallurgie et de la Géologie Appliquée, 16, Quai des Etats-Unis. Price: Mines, 150f.; Métallurgie, 200f.; Géologie appliquée, 150f.

The Commercial Motor Transport Exhibition at Olympia.

No. II.*

Vickers-Armstrongs, Ltd.

The development of mechanisation in the Army has demonstrated the utility of the vehicle fitted with caterpillar tracks for crossing country impassable to ordinary wheeled lorries. Vickers-Armstrongs, Ltd., believe that vehicles that have been found useful in the Army are also likely to be useful for civil purposes in undeveloped countries, and in consequence the firm has produced two vehicles fitted with caterpillar tracks, specially designed for civil use. One of these, known as the Carden-Loyd tractor truck, is illustrated in the engraving, Fig. 13. The firm claims that these machines can haul loads across ground over which no other tractor could go, and that they are designed to operate continuously on very rough, or very swampy, ground without damage to themselves.

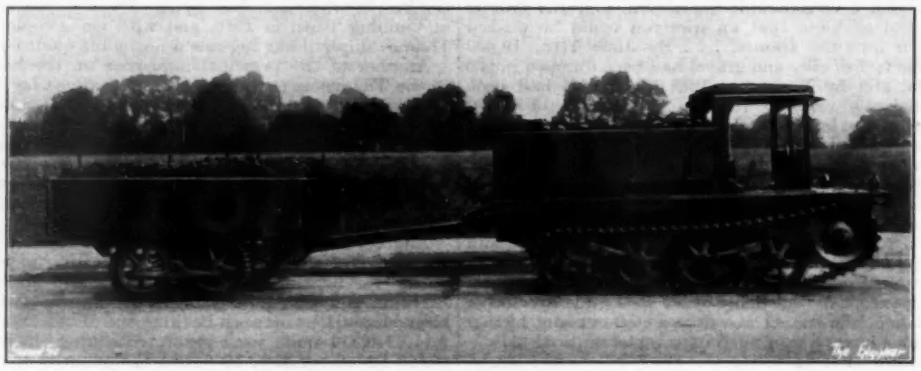


Fig. 13—Carden-Loyd Tractor Truck and Trailer—Vickers-Armstrongs

The truck illustrated in the engraving is fitted with an engine having six cylinders, 3in. bore and 4½in. stroke, with a nominal Treasury rating of 21·6 H.P. The gear-box provides five forward speeds and one reverse. The drive is then taken through bevel and spur gears to the driving axle, in which are incorporated multi-plate fan-cooled clutches for steering. On the road the tractor can reach a speed of 25 m.p.h. It has a length of 12ft., and width of 6ft. 2in., and a height to the top of the driver's cab of 6ft. 2in. Its suspension is specially designed to be suitable for the purpose in view, and a short-pitch, smooth-shoed track, which will not damage roads even at speeds above 20 m.p.h., is fitted. It is capable of carrying a load of 1 ton 10 cwt., and will draw a trailer mounted upon tracks capable of carrying 30 cwt. Swampy country can be crossed without the necessity for affixing spuds, but in case any particularly bad ground must be met, arrangements are incorporated for affixing spuds easily. The maximum width of the trench that can be crossed is 4ft., while the machine is also capable of fording water to a depth of 2ft. 6in. The controls are much the same as those for an ordinary lorry, excepting only that instead of a hand wheel, levers are mounted directly in front of the driver's seat on the offside of the vehicle for steering. The petrol consumption is approximately 6½ miles to the gallon, depending considerably on the nature of the ground crossed. On the stand, arrangements have been made for showing a film which demonstrates very well the extraordinary capabilities of the machine for crossing rough and swampy country. Comfort in such journeys, however, must be a minor consideration!

The other exhibit on the stand is a heavy cross-country lorry on caterpillar tracks, mounted on two bogies, the forward one of which is used for steering. This lorry can carry a paying load of 6½ tons, with which the ground contact pressure with the standard shoes on the track is 15 lb. per square inch. If special swamp plates are fitted, this figure is reduced to only 6 lb. per square inch, so that the vehicle practically floats on the swamp. The lorry has a maximum speed of 18 m.p.h. and consumes petrol with a paying load of 6½ tons at the approximate rate of 2½ miles per gallon. The engine of four cylinders, 4¼in. by 5½in., has a Treasury rating of 36 H.P., and actually develops 80 B.H.P. at 2400 r.p.m. The gear-box provides five forward speeds and a reverse. The lorry can cross streams 3ft. deep.

Albion Motors, Ltd.

The single-deck omnibus illustrated in Fig. 14 is exhibited by Albion Motors, Ltd., of Scotstoun, Glasgow, and is an entirely new production. It is capable of seating thirty-two persons. The body of the omnibus was built by W. Alexander and Sons, of Falkirk. The six-cylinder, 36–85 H.P. petrol engine fitted to the chassis is illustrated in Fig. 15. It will be seen that it has a high cam shaft with inclined overhead valves, the arrangement allowing the cylinder heads to be removed without disturbing the timing. In the engraving the covers protecting the valve gear have been removed to show the rockers. Seven bearings are provided for the crank shaft, while particular attention has been directed towards the construction of a crank case of great rigidity to ensure freedom from vibration. At the highest points of the timing gear casing and of the valve rocker covers breathers are situated in order to get over the difficulties not infrequently caused by the formation and condensation of steam inside the engine, causing rusting of important parts. With the same object in view internal projections that might form traps for the vapour are eliminated. A single-disc clutch drives a neat and unusually shallow four-speed gear-box. Both main and lay shafts are mounted on three ball or roller bearings, and this, with the provision of fine pitch constant mesh wheels for the third speed, ensures quiet running on this gear. The transmission is by means of an open propeller shaft with special Albion universal joints to an underslung worm axle of the full floating type. The foot brake acts on all four wheels through a vacuum servo with a master adjustment. The hand brake operates independently on the rear wheels. The hand and rear foot brake cam shafts are concentric, but in separate bearings, so that no binding can possibly occur.

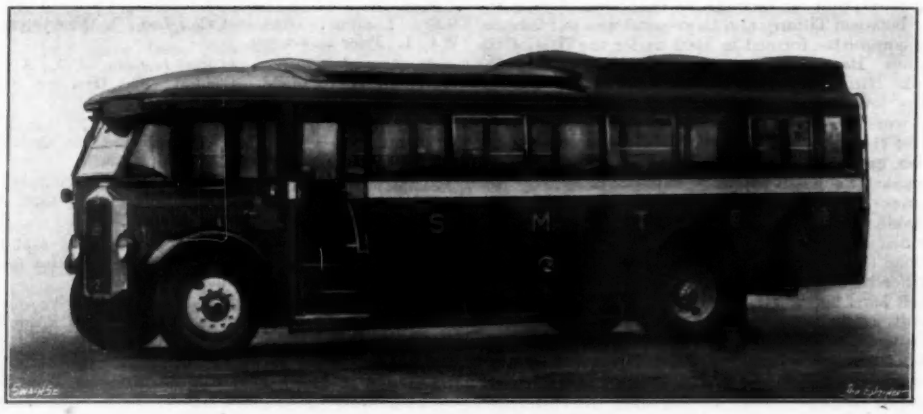


Fig. 14—32-Seater Single-Deck Omnibus—Albion

It is claimed that the arrangement of the engine auxiliaries is particularly accessible. Other points of minor detail are the provision of adjustment of the oil pump gland and the valve rockers; exceptionally complete provision for the lubrication of the chassis; master adjustment of the four-wheel brakes, and detachable brake drums so arranged that the brakes can be re-lined without disturbing the hub bearings.

Besides the omnibus just described, the firm is also exhibiting a 20–42 H.P. low-built, 20-seater, designed for country service and provided with a four-cylinder engine. The body is designed to seat three abreast instead of the more usual four, so that the over-wide appearance of some 20-seaters is avoided. The overall width is less than 6ft. 3in. Goods models are also shown on the stand.

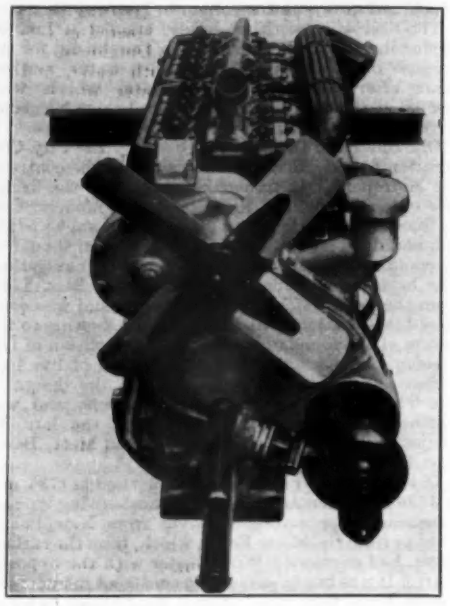


Fig. 15—36-85 H.P. Petrol Engine—Albion

Auto-Klean Strainers, Ltd.

Among other important questions which have arisen following the recent rapid progress made in the use of heavy-oil, compression-ignition engines for commercial transport vehicles is that of the straining of the oil fuel. With the means adopted for producing that fine degree of atomisation now used to obtain efficient and complete combustion, it is very necessary to remove from the fuel the very finest particles of dirt or other foreign matter, which may have gained an access to the fuel system.

A new type of oil strainer which has been specially designed for such duties is shown for the first time at Olympia on the stand of Auto-Klean Strainers, Ltd., of 40, Trinity-square, E.C. 3. As the accompanying drawing indicates, the central strainer is of the firm's standard "Auto-Klean" self-cleaning

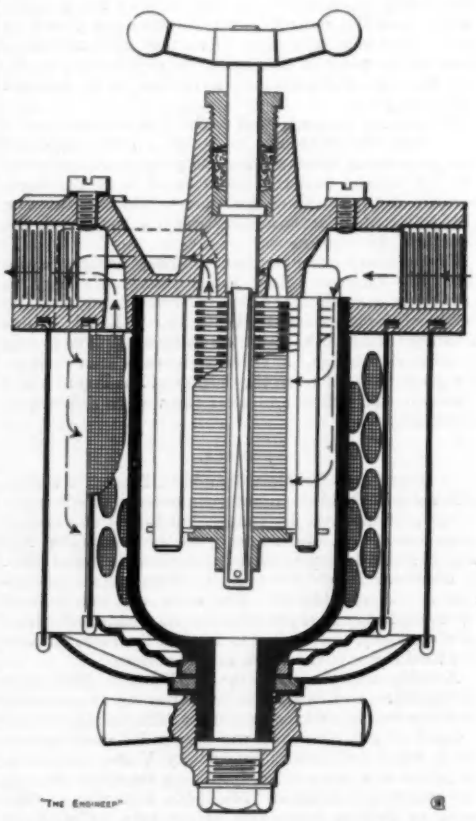


Fig. 16—Fuel Oil Strainer—Auto-Klean

* No. I. appeared November 6th.

pattern, but in this model it is surrounded with a sleeve of very finely woven Monel metal cloth, which is carried on a perforated metal cage.

The centre strainer has an equivalent of 150 mesh and the preliminary straining of the fuel takes place through it, leaving the Monel metal cloth to return any ultra-fine specks which may have passed through the Auto-Klean cartridge.

The centre strainer retains any water which may be present in the fuel and also the majority of the other foreign matter, a plug for the quick removal of the deposited dirt being provided at the bottom of the strainer casing. The centre strainer is cleaned in the usual way by turning the handle at the top. Tests made by the makers show, we understand, that a strainer embodying the features referred to will give good service for about 3000 hours before it becomes necessary to clean the Monel metal cloth. When this operation has to be carried out it is only necessary to slacken off the fly nut at the bottom of the strainer, which enables the Monel cloth to be removed in a few seconds. This new type of strainer will, in the final designs, embody the special requirements of engine builders, and it is to be manufactured in standard units.

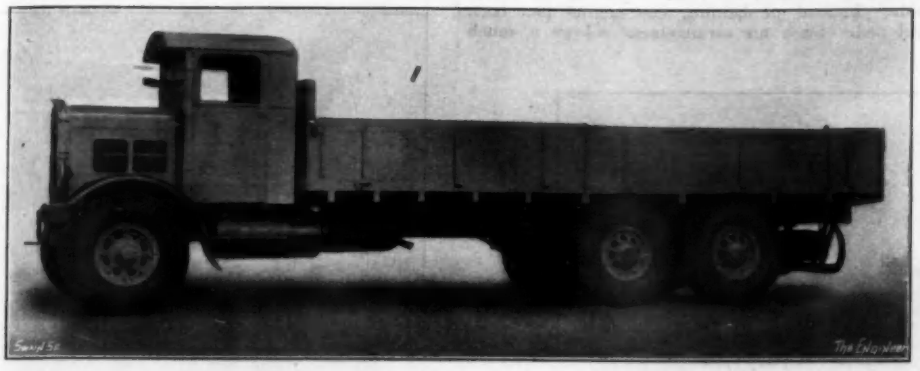


FIG. 17—12-TON SIX-WHEEL LORRY—SCAMMELL

SCAMMELL LORRIES, LTD.

A new design of 12-ton rigid six-wheel chassis is to be seen on the stand taken by Scammell Lorries, Ltd. The engine fitted to this chassis, while having a number of improvements, is a standard production, and is in most respects similar to that shown at the last Exhibition. It develops 80 H.P. in four 5in. by 5½in. cylinders, cast in pairs. The Treasury rating is 40 H.P. Each cylinder is fitted with a hardened steel liner. Overhead valves operated by enclosed rocker gear are fitted. A Sims magneto is incorporated in the design and has an automatic advance The gear-box gives four speeds and the engine and gear-box assembly is mounted in a three-point suspended sub-frame.

The main frame of the lorry is made up of pressed channel section carbon steel, and has a depth of 14in. The drive passes from the gear-box through a universally jointed transmission shaft to a spiral bevel drive differential. From the countershaft the final drive to the forward axle of the bogie is by duplex chains. The overall length of the chassis is 30ft., with a wheel base of 19ft. and a track of 6ft. 1in. With an approximate chassis weight of 5 tons 15 cwt., a body space of 22ft. by 7ft. 6in. is provided. This chassis is illustrated in the engravings, Figs. 17 and 19.

The biggest lorry on the stand is an articulated eight-wheeler, to carry 14 to 17 tons. It is fitted with an engine similar to that installed in the 12-ton chassis described above. The details of the motive unit as regards the drive are also similar. The carrier is constructed of pressed channel section nickel steel with a depth of 14in. The body has hinged and detachable sides, with a length of 24ft. 6in. by a width of 7ft. 6in. The overall length of the complete vehicle is 33ft. and it has an approximate weight of 8 tons.

A puncture indicator is being fitted to some of the lorries on this stand. Between the wheels on the rear bogie a metallic strip is supported between two contacts in such a way that relative movement of the wheels swings it into contact with one or the other. Each time that connection is made a current can flow to light a lamp or other indicating device in the cab. Normally, even on a bumpy road, the connection is only made with the contacts for a very short time, so that the lamp in the cab will do no more than flicker. If, however, one of the giant pneumatic tires with which the wheels are fitted is punctured, that particular wheel will drop and the metallic strip will be brought into continuous connection with one of the contacts, causing the lamp in the cab to burn steadily.

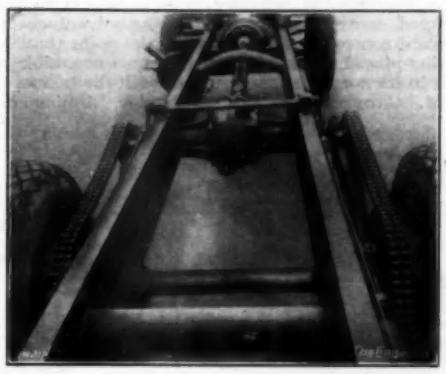


FIG. 19—CHASSIS DETAILS—SCAMMELL

FODENS LTD.

On the stand of Fodens Ltd., of Elworth Works, Sandbach, there is an interesting display of both steam and oil-engine driven lorries. The largest exhibit on the steam side is the Foden Speed-Twelve rigid six-wheel wagon, which is fitted with a platform body. The engine and boiler, and the auxiliary equipment, incorporate the latest developments, whilst a noticeable feature is the particularly good visibility from the driver's cab. Ease of control is another feature, while the important factor of accessibility has not been overlooked. The vehicle is designed to carry a useful load of 10 to 12 tons at a legal speed of 20 miles per hour. The boiler is of the semi-horizontal type, and works at 275 lb. per square inch. It is fitted with a superheater, giving a steam temperature of 600 deg. Fah. The engine is a two-cylinder double-acting unit, with a bore of 5in. and a stroke of 7in. It is designed to develop 90 B.H.P. at about 1100 r.p.m., and at that speed the two-speed gear gives road speeds of 26 and 10 miles per hour. The pneumatic tires are of the 40in. by 8in. high-pressure pattern for all wheels, twin tires being fitted on the rear wheels. Another exhibit, which we illustrate in Fig. 18, is the Foden Speed-Six steam wagon, which is a vehicle of entirely new design, fitted with pneumatic tires. The wagon shown at Olympia is equipped with a hydraulically operated three-way tipping body. A special feature is the boiler, which is of the water-tube type with a fire-box of circular construction. There are no stays in the water spaces, all surfaces of the fire-box being circular. In view of the low and horizontal position of the boiler in the frame of the vehicle, the firing is easily carried out through a short tapered chute leading through the top of the fire-box. A large dome forms part of the boiler, through which the steam passes before reaching the superheater. The steam conditions are similar to those referred to in the above description of the 12-ton wagon. The engine is of the two-cylinder high-pressure type, with 5in. bore and 7in. stroke cylinders, and the two-speed gear-box is designed to allow the wagon to climb gradients of 1 in 3·5 fully loaded, and to travel at road speeds up to 45 miles per hour. As will be seen from our illustration, there are two water tanks, a capacity of about 168 gallons being provided. A special feature of the cab design is the arrangement of the driver's and fireman's seats, close to the front screen, so that without effort the driver can see the full width of the road, even at a distance of less than one yard forward of the front wheels. The control levers are centralised, and the steering gear has been designed for ease of manœuvring. The wheels, tire equipment, and braking arrangements, are standard.

The firm is also showing a 6-ton lorry which is equipped with a 72 B.H.P., 1300 r.p.m. six-cylinder compression engine by Gardners, of Patricroft. This lorry is fitted with a platform body.

RICHARD GARRETT AND SONS, LTD.

Noteworthy among the exhibits on the stand of Richard Garrett and Sons, Ltd., of Leiston, is a 6-ton lorry equipped with a Blackstone six-cylinder, high-speed, compression-ignition engine, designed for utilising heavy fuel oils. The engine is of the type previously described in our columns, and has a bore of 4¼in. by 6in. cylinders, the designed output being 55 to 60 B.H.P. at 1000 r.p.m. The gear-box gives four forward speeds and a reverse, has a silent third speed forward, and a gate-type change. The drive to the back axle is by means of tubular cardan and propeller shafts, with universal joints. A forward driving position has been adopted and the steering gear is of the Marles irreversible type. The auxiliaries include a 24-volt starting motor, with a lighting set and a tire pump. Single 40in. by 8in. pneumatic tires are fitted to the front wheels, and double tires on the rear axle. The vehicle has a wheel base of 15ft. 3in. and is complete with a flat platform body, having hinged sides and tailboard. Another exhibit which we illustrate in Fig. 20 is an industrial tractor on pneumatic tires, which is driven by a 42 B.H.P. Aveling and Porter "Invicta" compression-ignition oil engine. This engine, it may be recalled, recently gained a non-stop endurance record in agricultural tractor trials.

The engine has a designed speed of 1000 r.p.m., and the gear-box gives road speeds of 3 up to 10 miles per hour. A special device stops the engine in the event of a failure in the lubricating oil supply. The front wheels are fitted with 27in. by 6in. tires, and 42in. by 9in. tires are used for the back wheels. The tractor is equipped with an electric lighting set, and the canopy shown in our illustration is specially

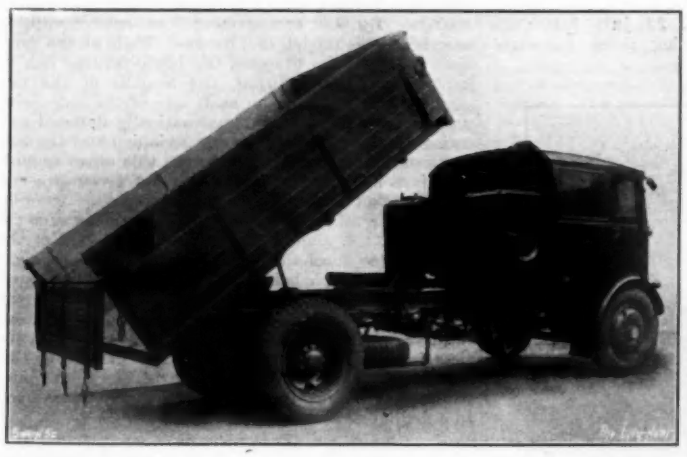


FIG. 18—6-TON STEAM WAGON—FODENS

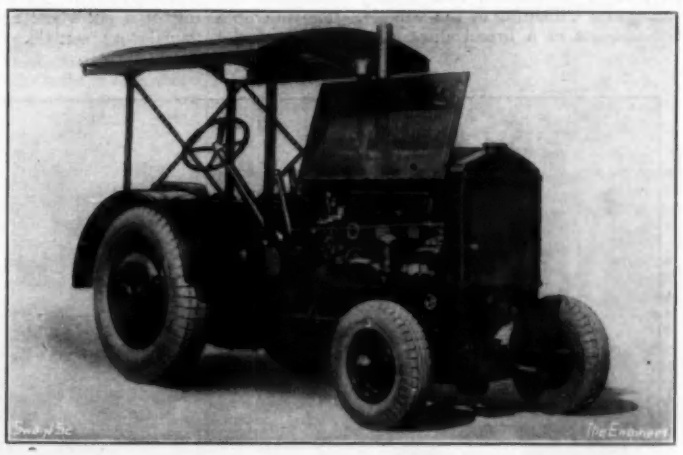


FIG. 20—42 B.H.P. HEAVY OIL ENGINE TRACTOR—GARRETT

designed for tropical service. This machine can be fitted with either "Blackstone" or Aveling "Invicta" high-speed oil engines.

A further exhibit, shown in Fig. 21, is a "Garrett" rigid six-wheel steam wagon, which this year appears for the first time with pneumatic tires. It follows the normal design and has a vertical cross-tube boiler with a designed working pressure of 275 lb. per square inch. The engine is built for a maximum output of about 95 B.H.P., and it has 4½in. by 7½in. cylinders.

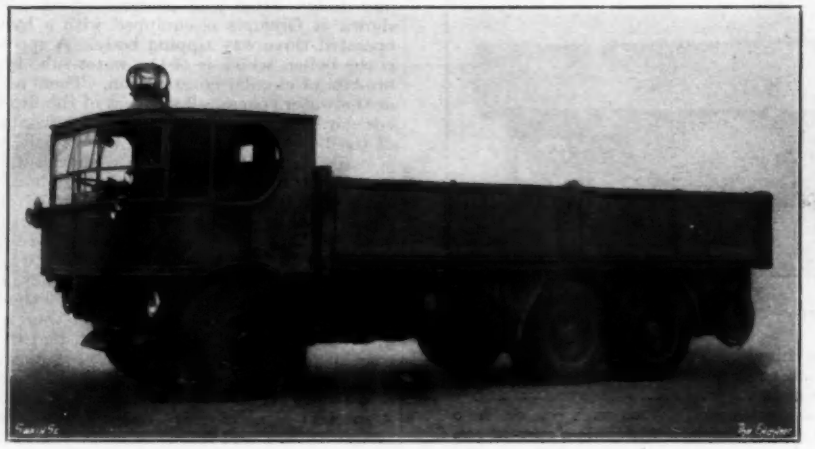


FIG. 21—RIGID SIX-WHEELER STEAM WAGON—GARRETT

The tires, which comprise single 20in. by 12in. low-pressure tires on the front wheels and twin high-pressure 40in. by 8in. tires on the rear wheels, are designed for a weight of 11 tons. The firm's patented pivotal rear axle arrangement has been retained, with a double chain drive to the forward pair of wheels on the rear bogie.

The model exhibited at Olympia has a flat platform body, with dimensions of 17ft. 6in. by 7ft., with a depth of 1ft. 9in., hinged sides and tailboard being provided. It is furnished with a movable floor, which was supplied by the Principality Wagon Company, Ltd., of Cardiff, and greatly facilitates the loading and unloading of the vehicle. The movable floor consists of a broad sheet of flexible material supported on small rollers and mounted at each end on winding rolls.

The design of the driver's cab has been considerably improved, and it now gives exceptionally good visibility. The engine has a two-speed gear, foot acceleration control, and three independent sets of brakes operated by hand, foot and steam respectively.

GARNER MOTORS, LTD.

Owing to the fact that regulations have come into force limiting the dimensions of commercial wagons, particularly in connection with maximum length and the loading of axles, the plan of placing the driver beside, instead of behind, the engine has been developed. Such an arrangement allows a much greater percentage of the chassis length to be used for carrying a load. A number of firms have specialised in converting the ordinary type of wagon to this forward control type. Against the advantages of forward control, however, there is the point that the engine placed inside the cab is not so accessible as it is in its normal position underneath the bonnet in front. Garner Motors, Ltd., of Tyseley, Birmingham, have got over the difficulty in the ingenious manner which is illustrated in Fig. 24. The wing on each side, together with the door sill and the footplate forming the floor of the cab, are hinged to the front of the cab bodywork. This hinge can be seen in the engraving of a six-wheel chassis, Fig. 23, just below the ventilating scuttle. By releasing three fasteners the assembly can be swung outwards and forwards, leaving room for the mechanic to sit on the front axle and making the engine exceptionally accessible. The photograph reproduced in Fig. 24 shows how convenient the position of the mechanic is.

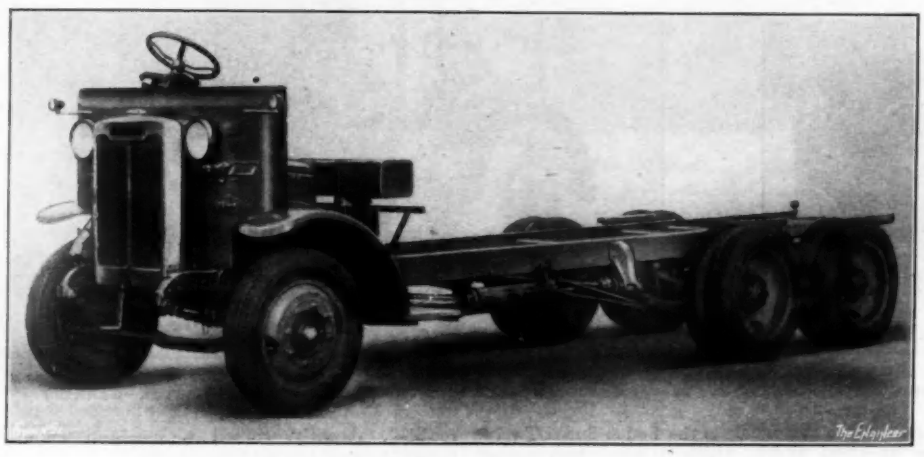


FIG. 23—3-TON RIGID SIX-WHEELED CHASSIS—GARNER

The chassis illustrated in Fig. 23 is that of the 3-ton rigid six-wheeled forward control model. The most interesting feature of this wagon is the generous articulation of the rear wheels. The rear axle is not driven. The arrangement of the springing and the compensating linkage of the brake gear is shown in the drawing, Fig. 22. The leading axle of the bogie

FIG. 24—ENGINE ACCESSIBILITY—GARNER

is spiral bevel driven, and is of the full floating type, while the bed of the trailing axle is tubular fitted with hubs, brakes and brake drums, all interchangeable with the leading driving axle. The interest of the arrangement lies principally in the suspension. Each axle supports the chassis through a pair of semi-elliptic springs, which are coupled together by compensators. It will be noticed that the axles are not mounted at the centres of the springs, being offset, the driven axle being behind the centre of its springs, while the trailing axle is forward of the centre of its springs. By this arrangement long springs, 4ft. in length on this model, can be used, while at the same time the distance between the bogie centres can be kept small. In addition, the lengths of the two portions of the spring on each side of the axle being unequal, road shocks are automatically damped out, owing to the difference in the periodicity of the two parts of the spring; furthermore, this offset mounting gives increased articulation for a given size and movement of the compensator mechanism. In order to obtain equal reaction in the movement between the two axles, the angle of the bell crank levers of the compensator mechanism is made less than a right angle, the principle being much the same as that represented by the stub axles and track rod of an ordinary front axle. If the axle centres vary to any large extent owing to articulation, excessive wear is caused on the tires, and other working parts. The makers of this chassis claim that this variation is less than $\frac{1}{16}$in., while the twisting stresses in the springs are reduced to a negligible amount.

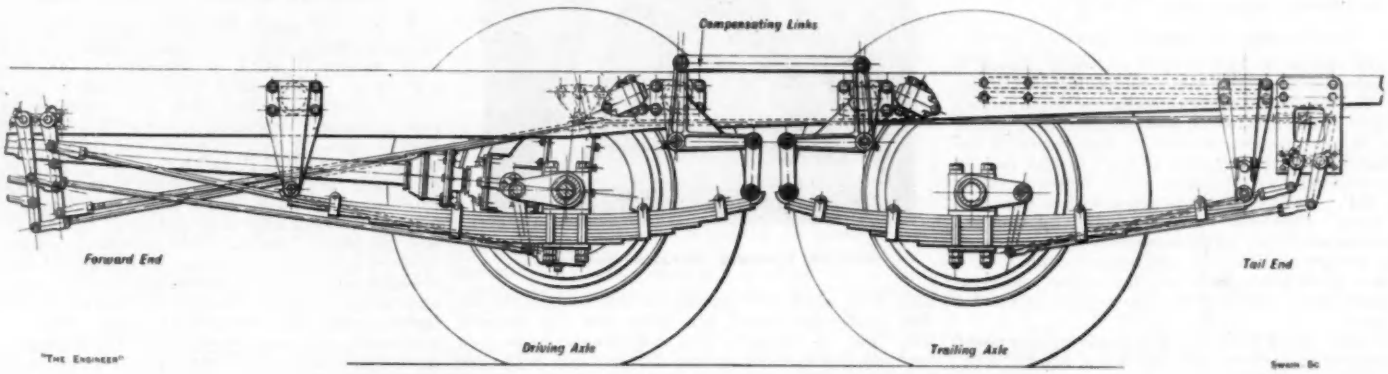


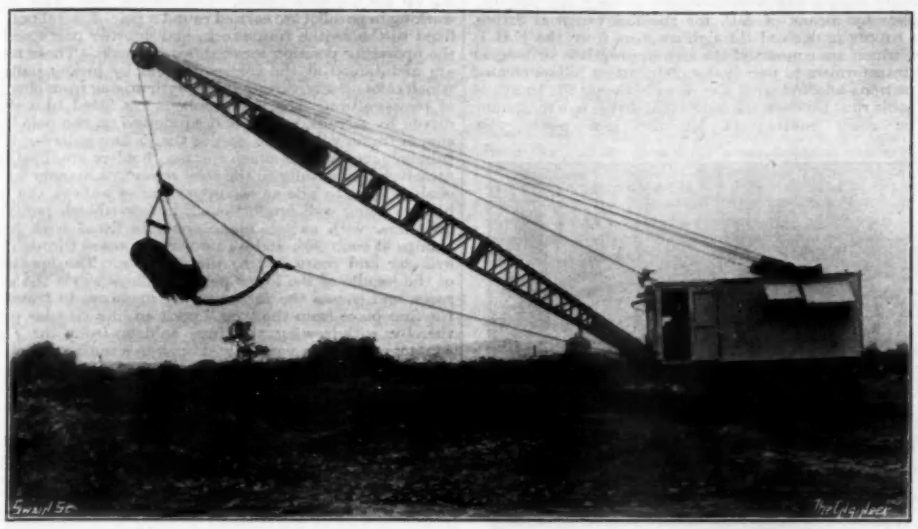
FIG. 22—SPRINGING OF THE REAR BOGIE OF 3-TON CHASSIS—GARNER

(To be continued.)

THE official returns rendered to the Electricity Commissioners show that 1035 million units of electricity were generated by authorised undertakers in Great Britain during the month of October, 1931, as compared with the finally revised figure of 987 million units in the corresponding month of 1930, or an increase of 7 per cent. During the first ten months of 1931 up to the end of October, the total amount of electricity generated by authorised undertakers was 9083 million units, as compared with the finally revised figure of 8729 million units for the corresponding period of 1930, representing an increase of 4 per cent.

160 B.H.P. OIL-DRIVEN DRAG-LINE EXCAVATOR

RUSTON-BUCYRUS, LTD., LINCOLN, ENGINEERS



A New Excavator.

The illustration which we reproduce below represents the latest type of excavator made by Ruston-Bucyrus, Ltd., of Lincoln, the detail construction of which has been referred to in The Engineer on several occasions, notably in the issues of August 14th and March 6th of 1931, and February 28th, 1930. On those occasions we have described the machine as it may be driven by an oil engine or an electric motor connected with any convenient source of supply.

The machine which we illustrate is one of the largest of its kind which has been produced by the makers, and is driven by an oil engine of 160 H.P., having six cylinders. As a shovel it is fitted with a bucket of 2¼ cubic yards capacity on a boom 31ft. long or, alternatively, it can have a bucket of 2 or 1½ cubic yards capacity with a corresponding increase in the outreach.

As a dragline, as represented in the illustration, the jib length may be as much as from 50ft. to 75ft., with skips ranging from 2½ to 1½ cubic yards.

The standard width of the caterpillar travelling tracks is 3ft., but the machine may be equipped with tracks 42in. wide, which give a total bearing area of 111 square feet, and enable it to travel over very soft ground.

Road-making Machinery in France.

The construction of road-making machinery is a recent development of French engineering which, in this respect, has lagged behind Great Britain and the United States, and until of late years most of the machinery came from those countries, while Germany is now a competitor for road-making plant. It was only after the Armistice that French manufacturers turned their attention to such machinery, which had to be imported on a large scale to allow of the reconstruction of practically all the roads throughout the country, and the prominence given to road construction in the national programme of public works, and the intention of the Government to authorise an expenditure of a further sum of nearly 500 million francs on roads as a means of alleviating unemployment, have widened considerably the field for the employment of machinery. The efforts of French makers to supply what is needed are retarded by continual developments in the art of road making, which has not yet settled down to the best methods of construction in view of the changing conditions of motor traffic; for example, the use of roads in connection with the railways. The problem now is to build roads that will stand the heaviest traffic without undue cost of construction and upkeep. The methods to be employed will necessarily influence the design and construction of machinery. Progress is slow because it can only be based on experience. In view of the multiplicity of questions arising out of this problem all the makers of road-making machinery have formed a Syndicat Général de la Route which will hold periodical exhibitions and conferences, when manufacturers, engineers and specialists will meet to discuss matters relating to road construction.

The first exhibition and congress were organised last week in the Parc des Expositions at the Porte de Versailles, Paris, and preceded immediately the Public Works, Road and Transport Congress which is being held in London. The machines and plant of French manufacture were shown in one of the big permanent exhibition buildings, and consisted for the most part of apparatus for preparing tar and laying it on the road, concrete mixers, conglomerate blocks of all kinds for road surfaces, and generally, there was more in the way of road material and surface-treating plant than actual road-making machinery, though one firm exhibited a machine for laying out one side of the road to the required cross section form by ploughing up towards the centre. This and other machines were shown in operation on grounds outside the building. French makers are prepared to supply all the ordinary classes of material for road repairs and maintenance, and they are also producing such machines as scarifiers, but they have hardly yet ventured upon the manufacture of high-duty road-making machinery, because there is much to be learnt about what is being done abroad before they can safely embark upon the construction of relatively costly plant without fear of being stifled by competition. Nevertheless, they are making headway, notably in oil-engined road rollers, and while at one time English road rollers were employed almost exclusively they are being superseded to a large extent by French machines. Home manufacturers cannot supply all that is required, and the practical side of English road-making and road-treating machinery is appreciated by French engineers, who cannot afford to buy from home firms when they can obtain more suitable and probably cheaper machines from abroad. The Foden steam lorry, equipped for tarring roads, is a case in point. The oldest and leading makers of steam road rollers, who, until recently at any rate, built rollers with English oil engines, complained at the Congress that French engineers did not give so much preference to French products as they should do, and hoped that the gatherings now instituted would lead to a closer understanding between road engineers and manufacturers. This depends upon whether French makers can supply machines as practical in character and as cheaply as foreign manufacturers. There are so many systems of road construction under test that different methods will continue to be adopted until the less suitable amongst them are eliminated, leaving a certain number that may come satisfactorily out of prolonged tests, and manufacturers of road-making material will probably have to adapt themselves to new conditions of road making. Makers in France can, therefore, hardly claim special favours so long as there continues this international investigation into methods of road making that will give the best results. Moreover, there is no method that can meet all cases, for local materials must be used wherever possible, and much experimental work has yet to be carried out in order to ascertain how these materials can be used to the best advantage.

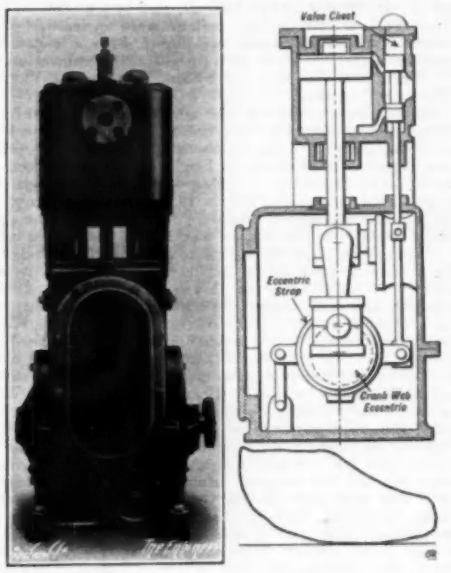
A few years ago, silicate of soda or potash was recommended for use in binding material because it was employed in the building trades to harden porous stone. The trials on the road were a failure, but at the Congress it was shown that by employing silicate with suitable materials excellent results were obtained, and the treatment of road surfaces with silicate of soda is regaining favour. The French are doing a great deal of interesting and useful work in inventing and testing new road materials, some of which appear to be giving good results from the point of view of their durable and non-skidding qualities, but as roads must be constructed with cheap and easily procurable materials, the choice is at present limited. The use of macadam bound with cement has proved satisfactory in many parts of France, and is meeting with favour. In proof of the good wearing qualities of the "mosaic" system of laying small stone setts, which has been employed for many years in the North of France and in Belgium, it was pointed out at the Congress that, after the war, it was found that roads built in that manner had stood remarkably well the heavy German traffic in the war zone.

A Novel Design of High-speed Steam Engine.

At first sight it would seem that little could be done to improve upon the present-day designs of small high-speed steam engines. The construction of such machines, as designed by a number of makers, shows only minor variations in detail. Unusual designs have been produced with a fair measure of success, of which we can call to mind the swash-plate type and others, in which the conventional arrangement of the cylinders in line has been altered to a "V" or radial form, but in general the design of the high-speed steam engine has not been improved upon for many years.

At a glance the machine illustrated by an engraving on this page does not appear to differ to any large extent from other vertical high-speed steam engines. However, further examination will show that two valves are incorporated for the control of one cylinder and that the valve chests and valve rods are placed in front of instead of in line with the cylinder. This engine has been produced by Drysdale and Co., Ltd., for driving circulating pumps, dynamos, and other auxiliary machinery in the belief that users will be willing to install a somewhat more costly machine if the concomitant advantage of an improved steam consumption is also present, while at the same time the design does not depart too radically from the conventional that has proved so reliable in service. In order to obtain from a single-cylinder engine a consumption comparable with that obtained from a compound, the makers have provided separate inlet and exhaust valves and have placed them side by side at the front of the engine. Each valve is arranged with its connecting ports tangential to the cylinder walls. Several advantages are claimed by the makers for the arrangement. The use of separate valves allows the compression to be controlled irrespective of the position of cut-off and reduces steam leakage considerably, while at the same time each valve can be properly proportioned to suit the steam flow through it, so that wire-drawing is much reduced. The arrangement of the valve ports is stated to be such that the momentum of the steam is employed in ejecting condensed water, giving a dry cylinder at admission and a quiet running engine. The indicator card on this page will enable readers to appreciate these claims.

The situation of the valves at the front of the engine necessitates a novel construction of the valve gear, and the special mechanism illustrated in the diagrammatic drawing is employed. The webs of the crank are made very wide and part of the surface is machined to form a sheave, which is surrounded by an excentric strap having projections to carry links at both the back and the front of the engine. That at the front is connected to an excentric rod which is fastened to the piston-rod by a pin joint, while that at the back is connected by a link to a fixed point on the crank case. When the crank rotates, the projection on the excentric strap at the front of the



EXTERNAL VIEW, DIAGRAMMATIC SECTION, AND INDICATOR CARD OF STEAM ENGINE

engine is forced to follow an elliptical path, the largest axis of which is vertical, and in this manner each valve is driven from one of the crank webs.

In other respects the engine differs but little from the more conventional design of vertical steam engine. But the makers claim that the mechanism is as simple as that in an ordinary engine, while the consumption is 25 per cent. better. Actual test figures, as supplied to us by the makers, show a steam consumption of 25 lb. per I.H.P. and 29 lb. per B.H.P., using saturated steam at 200 lb. per square inch pressure. The single-cylinder type of engine is made in a range of sizes from 15 H.P. to 100 H.P., while twin high-pressure sets are also constructed and give double these powers.

RAILWAY RATES TRIBUNAL.

The announcement is made by the Secretary to the Ministry of Transport that, on the retirement of Mr. Locket and Mr. Jepson from the appointments of permanent members of the Railway Rates Tribunal, established under Sec. 20 of the Railways Act, 1921, Mr. H. E. Parkes has been appointed as the member with experience in commercial affairs, and Mr. John Quirey, C.B.E., M. Inst. T., as the member with experience in railway business. The new appointments took effect on November 4th.

Mr. Locket and Mr. Jepson were original members of the Railway Rates Tribunal, when it was first set up in 1921. Before his appointment Mr. Locket was a partner in the business of Gardner, Locket and Hinton, coal factors, and Mr. Jepson was assistant to the general manager of the London and North-Western Railway.

Mr. H. E. Parkes was, before his appointment to the Railway Rates Tribunal, director of E. Parkes and Co., Ltd., West Bromwich, and chairman of the Birmingham Corrugated Iron Company, Ltd., as well as being a director of the Austin Motor Company, Ltd., and certain other companies. He has served on the Finance and Transport Committees of the National Federation of Iron and Steel Manufacturers, and was also Vice-president of the Association of British Chambers of Commerce, an ex-President of the Birmingham Chamber of Commerce, and a member of the Birmingham City Council. He has been a member of the National Railway Wages Board set up under the Railways Act, 1921, and a member of the Management Committee of the British Industries Fair.

Before his appointment to the Railway Rates Tribunal,

Mr. Quirey was a Vice-president of the London, Midland and Scottish Railway Company. He commenced his railway career in 1882 in the audit office of the Belfast and Northern Counties Railway, which in 1903 was acquired by the Midland Railway, and thereafter known as the Northern Counties Committee. In 1917 he joined the Midland Railway Company and in 1920 was appointed chief accountant. In 1923, following the grouping of the principal railway companies, he became joint accountant to the London, Midland and Scottish Company, and in the following year accountant-general. In 1927 he was elected a vice-president of the London, Midland and Scottish Company, in control of the finance and service departments, and subsequently of the traffic operating and commercial sections.

A New Turbo-Generator Set at Brighton.

SINCE the Brighton Corporation's Southwick power station was opened in 1905 and took over the load of the less favourably situated station in North-road, the turbine plant has been superseded by larger and more efficient units, although a certain amount of the original boiler plant is still in operation. Neglecting the earlier changes, the more recent developments date back from 1924, when a 6000-kW Metropolitan-Vickers set was ordered, together with an Allen 500-kW D.C. turbo house service set. Two Yarrow marine type boilers, each having a capacity of 40,000 lb. per hour, were installed at the same time; whilst in 1927 another 6000-kW Metropolitan-Vickers set and two 77,000 lb. per hour pulverised fuel fired Wood boilers were put into service. In 1928 Richardsons, Westgarth put down a 15,625-kW set, and two 60,000 lb. per hour Yarrow stoker-fired boilers were ordered. New cubicle type high-tension switchgear with a rupturing capacity of 750,000 kVA, with provision for connection to the Grid, was also supplied by the Metropolitan-Vickers Electrical Company.

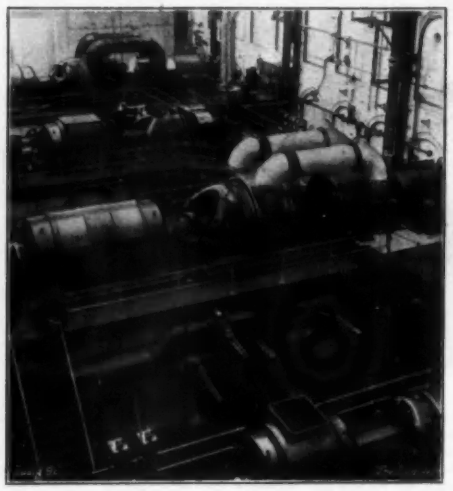
Largely as the result of the new areas that have been added to the Brighton Corporation and the prospect of supplying current to the Southern Railway for the operation of part of its London to Brighton line it was deemed desirable to duplicate as far as output is concerned the largest generating unit, and in 1930 tenders were invited for another 15,000-kW machine. At that time the stop valve pressure of the station was 200 lb. per square inch, but as the four large steam-raising units had been designed for a working pressure of 350 lb. per square inch, it was deemed advisable to operate this section of the plant at this pressure and at increased superheat, a change that was made possible by providing the existing Richardsons, Westgarth machine with an additional impulse wheel. Needless to say, the new 15,000-kW set for which tenders were invited in August, 1930, was designed for the new steam conditions at the outset. Richardsons, Westgarth were awarded the contract for the new unit on October 23rd, 1930, but as a shortage of plant made it impossible to remove an existing reconstructed 2500-kW machine to make room for the new unit until the end of the winter load, the site for the new machine could not be cleared until the early part of this year. Notwithstanding this delay, however, the new set was ready for service on September 25th last. Speaking at a luncheon which followed the official inauguration on Wednesday of last week, the chief engineer, Mr. W. N. C. Clinch, expressed his appreciation of the contractor's rapid work, and said that it was to be regarded as an achievement of note.

The new turbine, which is to be seen in the foreground of the accompanying illustrations, is a three-cylinder machine, designed for an output of 15,000 kW at a speed of 3000 revolutions per minute, and to work with steam at a pressure of 320 lb. per square inch and a temperature of 750 deg. Fah. It has a high-pressure cast steel cylinder, with an impulse stage and reaction blading, an intermediate cylinder with reaction blading, and a double-flow low-pressure reaction-bladed cylinder. The governor system is oil controlled, and consequently levers are dispensed with. Steam is extracted at two points for supplying a low and high-pressure feed heater, the latter being of a new and patented type with hairpin bend tubes, and an automatic by-pass valve. The condensing plant is of the twin type with duplicate three-jet air extraction plant, and duplicate motor-driven condensate pumps fitted with a closed feed control valve, so that the whole of the feed, whether made up from the evaporator or surge tank, is deaerated. As on the first Richardsons, Westgarth set, steam evaporators for feed water make-up have been provided. The alternator, which was built by the Metropolitan-Vickers Electrical Company, generates at a pressure of 8000 volts, and its M.C.R. is 18,750 kVA.

In order to deal with the two steam pressures now employed it was necessary to rearrange the steam pipes and to connect the high-pressure main to the low-pressure main by means of a reducing valve with a de-superheater. A feed pump bay has been arranged in the turbine room for two 18,000-gallon per minute electrically driven Mather and Platt feed pumps and two 20,000-gallon per minute Weir turbo feed pumps arranged to come into operation automatically in the event of the electrically driven pumps failing, all these pumps serving the high-pressure boilers.

Like other stations working on modern lines, the Brighton station has given rise to chimney emission troubles, and during the recent alterations the opportunity was taken to devise means of removing the sulphur and grit in suspension in the flue gases, and particularly from those of the Wood powdered fuel fired units. A gas washer devised by the chief engineer utilises sea water and has been placed between the boiler outlet and the inlet to the induced draught fan. The resistance to the gas flow is said to be negligible, and as steps have been taken to prevent the gas temperature being reduced to dew point it is possible to operate the induced draught fans handling clean gases without corrosion of the fan runner. So satisfactory has the apparatus proved that it has been decided to install another washer of the same kind for dealing with the gases of the second Wood boiler. With the re-arrangement of the plant the opportunity was also taken to provide accurate measuring instruments for the determining of the performance of the turbine and boiler-house plant, and Kent steam and water flow meters have been put into service. With these new instruments and a well-equipped laboratory in charge of a qualified chemist it is hoped to maintain the plant at a high state of efficiency and justify the continuance of the station as an operating unit in the National electricity scheme. In order to deal with the increased works auxiliary load it has been necessary to augment the D.C. supplies by means of A.C. for the less essential drives. This supply is derived through reactors from the E.H.T. bars, which are connected through appropriate switchgear and transformers to two feeder distribution pillars erected in positions selected with a view to reducing the length of the cable runs between the individual drives to a minimum.

The main contractors for the new plant were

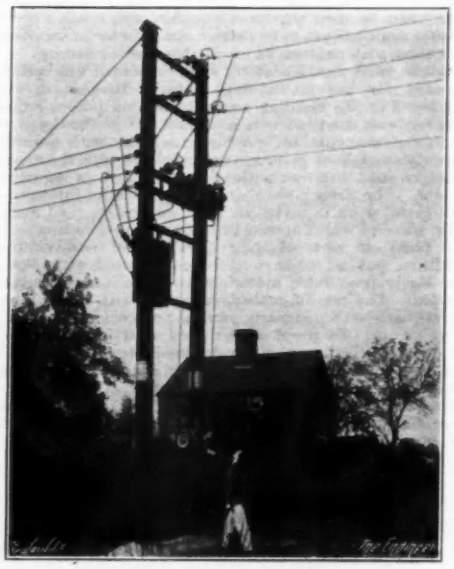


BRIGHTON POWER-HOUSE

Richardsons Westgarth, who designed the turbine and its auxiliaries; the Metropolitan-Vickers Electrical Company supplied the alternator and switchgear; whilst Vickers-Armstrongs, Ltd., were responsible for the condenser shells. The Staveley Coal and Iron Company, Ltd., supplied the circulating water pipes and Aiton and Co., Ltd., the steam piping. Mather and Platt supplied the extraction pumps, in addition to the feed pumps to which we have alluded. Under a separate contract Bierrum and Partners carried out the foundation work to the instructions of the engineer.

Overhead Line Pole Mounting Switch Fuses.

FROM George Ellison, Ltd., of Perry Barr, Birmingham, we have received particulars of overhead line pole-mounting switch fuses, which have been specially designed for use on power lines where a connection is made for a branch circuit or for a transformer. Besides serving as disconnectors they give automatic protection against overloads and faults. The switch can be opened or closed from the ground level, as shown in the accompanying illustration, without the use of any special appliance, and by turning a handle the fuses can be lowered to a convenient position for renewal by a man standing on the ground. A patented arrangement comprising pulley mechanism and steel rope serves for winding the set of fuses up or down, and as the fuse carrying structure is counterbalanced, it can be raised with little effort. It is also said to rise easily over the top pulleys and to engage in perfect alignment with the fixed contacts. The fixed insulators are so arranged in relation to the upper pulley centres that by turning the handle the fuse holders are withdrawn to a more or less horizontal position, as in the case of a switch. The fuse holders may be padlocked in the "off" or "on" position, or at any point in their travel from the contacts to the completely lowered position. As the knife switch opens, the circuit is broken at the higher contact jaw first, so that any magnetising current that may be flowing is dealt with on the contacts with horn breaks.



SWITCH FUSE ON TRANSMISSION POLE

A strong steel framework for fixing to the pole top carries a set of switch contacts mounted on pin type metal-capped porcelain insulators, with terminals for connecting up the overhead wires. Two endless steel wire ropes working in parallel are carried round a pair of metal pulleys fixed to the switch framework, and another pair fixed at the operating position lower down the pole. These ropes are maintained at the correct tension by jockey pulleys, which take up any variation in length arising from changes of temperature. The lower pulleys are fitted to a shaft driven by a crank handle and supported on the pole by a simple frame which also carries the jockey pulleys. Two tubular members, to which the fuse holders are fixed, are attached horizontally to the steel ropes in a manner which enables them to ride on the upper pair of pulleys, the fuse holders being well proportioned, hollow ribbed, porcelain cylinders, with switch blade contacts fitted with brass clamps at each end, and a fuse wire is passed through the cylinder and connected to the contacts. The operation of the handle of the lower pair of pulleys winds the steel ropes and causes the fuse carrying members to travel in the first place from the "on" position in a circular path, thereby withdrawing the fuse holders from the fixed contacts, and then vertically downwards until arrested by the counterweights checking the upper frame.

Torrefied Wood for Suction Gas.

THE last of the visits made by members of the National Fuel Congress at the Colonial Exhibition in Paris was to Triel-sur-Seine, where there is in operation the only plant that has yet been installed for the production of torrefied wood on the principle evolved by Professor Dupont, of the Forestry Institute at Bordeaux. The idea of torrefying wood is not new, since it is merely a process of dry distillation, but it is a process which aims at providing a cleaner and more convenient fuel and of a higher heat value than charcoal for suction gas plants. Professor Dupont has determined the conditions under which this can be done, and the results now being obtained are watched with interest in the hope that the new fuel for suction gas lorries will eliminate the troubles incidental to charcoal, notably its bulk, its absorption of moisture, and the difficulty of depending upon supplies and prices. Moreover, the progress of the charcoal suction gas producer is hampered by the reluctance of mechanics and drivers to handle a fuel that involves a lot of external cleaning. The only alternative fuel at present is wood, which, in its dry state, contains about 25 per cent. of water, as well as acetic, formic, and other acids that are detrimental to the plant as well as to the engine. Hence, if the water, tar, and acid constituents are eliminated, the use of wood in lorry suction gas plants will receive an impetus if the cost is acceptable. For the moment, there can be no question of building gas engines specially for lorries, and the best must be done with existing petrol engines in which the compression is increased to 6·5. In such engines there is a loss of power, sometimes up to 30 per cent., but oven so there is a notable economy in running lorries on suction gas. The new types of producers are much smaller and more efficient than the old, and the question of dead-weight is now of little importance. If therefore a better fuel than charcoal can be produced at no greater cost, the future of the suction gas lorry will be assured.

The plant at Triel-sur-Seine was designed and built by Monsieur Bourdet to supply torrefied wood for his fleet of lorries. The object is to distill the cellulose in the wood by subjecting it to a temperature of less than 300 deg. Cent., at which point it begins to carbonise and burn. The temperature is therefore kept at between 275 deg. and 290 deg. Cent., and to do this requires delicate adjustment and frequent attention. The plant consists of a cylindrical body with a concentric rotary tube, having internal plates to carry the wood round and forward until it is ejected from the apparatus. Gas is supplied to a burner from a suction gas producer using torrefied wood as fuel. The hot air passes around the rotary tube to the further end, and then returns through the tube, and finally to the chimney, at the base of which there is a fan to deliver some of the inert gases through a pipe to the opposite end, where the wood is ejected, in order to extinguish flames in the event of the wood beginning to burn. The operation is one of drying and distillation, and is facilitated by placing in the apparatus absorbent material, such as plaster, which takes up the water as well as some of the acid, tar, and other by-products during distillation. These can be recovered. On being ejected from the rotary tube, the wood contains some small incandescent pieces that would burst into flame if they were not damped out, and this danger, which is serious, is provided against in new plans of apparatus by letting the wood fall into receptacles that extinguish incandescent particles. One of the problems is to provide suitable machines for cutting the wood into the size of chips. This is done at Triel by feeding sticks into a rotary drum provided with knives, but improved machines for the purpose will be required if the system comes into extensive employment.

The capacity of the plant is 180 kilos. of dry wood an hour, equivalent to 140 kilos. of torrefied wood. Deducting the quantity of fuel for the suction gas producer providing gas for heating and for about 6 horse-power to drive the tube and fans, the net quantity of torrefied wood available from the 180 kilos. of dry wood is about 100 kilos. Green wood, containing from 45 to 50 per cent. of water, can be treated in the same way, but the initial drying process requires a bigger plant for the same quantity of wood, and in that case the net weight of distilled wood would, it is said, be not less than 40 per cent. In the case of charcoal it is only 25 per cent., and it is affirmed that the heat value of torrefied wood is 30 per cent. more than that of charcoal. No exact figures have yet been obtained about the cost of running the 5-ton lorries between the works on the Seine and another works at a fairly high altitude nearly a mile away, with some steep gradients, and until these are known it is impossible to say what is the precise value of torrefied wood as a means of cheapening heavy motor transport.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Position.

INDUSTRIAL conditions in the Midlands and Staffordshire are much the same as last week. Progress is slow, but steady, and the week has brought additional evidences of a redistribution of trade in favour of home manufacturers. The optimistic tone of the market is upheld despite the fact that iron and steel is not being bought in such increasing quantities as had been hoped for. There was a good attendance on 'Change in Birmingham to-day—Thursday—and keen interest was displayed. Apart from one or two minor changes there was no alteration in iron and steel values.

Steel.

The only change in the steel market is the advance of half-a-crown in quotations of mild steel billets, and even this is not justified by the increased volume of business being done by makers. Re-rollers continue to improve their position, but it is considered wise not to interfere further with prices. Bars re-rolled from continental material are sold at £6 17s. 6d. to £7, while all-British bars make £7 10s. to £7 12s. 6d., a slightly improved rate. The mills rolling heavy steel are not operating regularly, and the announcement by municipalities of the shelving of development schemes owing to economy does not encourage steel masters or constructional engineers in optimistic views. There is no change in finished steel prices, angles being £8 7s. 6d.; tees, £9 7s. 6d.; joists, £8 15s.; ship, bridge and tank plates, £8 17s. 6d., all subject to their respective rebates. Boiler plates are slightly easier at £8 15s. per ton.

Galvanised Sheets.

Galvanised sheet prices have receded further, despite the fact that production costs tend to advance. Demand from overseas markets continues unsatisfactory, and sheet makers here who are becoming short of orders have cut their quotations by a further 2s. 6d. to 5s. per ton in an endeavour to stimulate buying. The basis for 24-gauge galvanised corrugated sheets now stands at £9 7s. 6d. per ton f.o.b. Liverpool, though it is claimed by merchants that orders for substantial tonnages would be accepted at below the basis price. The fall in values brought some additional business to local mills, but it is insufficient to enable regular running to be maintained. Consumptive requirements at home continue at the recent level, and this trade is considered satisfactory. Galvanised sheet makers are competing keenly for all available business.

Staffordshire Bar Iron.

Irregular working is the general rule in the finished ironworks in South Staffordshire. There are not enough orders in any department to go round, but the lion's share is received by makers of marked bars and makers of tube strip. Values show no change on the week, marked bars are £12 per ton at makers' works, Crown quality ranges upward from £9 5s., nut and bolt and fencing bars are quoted £8 7s. 6d., while wrought iron gas tube strip varies in price from £10 10s. to £10 12s. 6d. Continental No. 3 iron contracted for some months ago is arriving in sufficient quantities to meet consumptive requirements, so that manufacturers in the Darlaston area have so far not had recourse to Staffordshire-made iron. Whether future events will give Staffordshire ironmasters a chance of successfully competing with the foreigner for the nut and bolt makers' business remains to be seen.

Pig Iron.

Pig iron business proceeds at a steady pace, but the output is generally considered to be in excess of the current consumption, particularly in the Northamptonshire district. Specifications are slightly better in some instances, but there is little new business about. Most consumers have now made arrangements for supplies to the end of the year, beyond which period business is not encouraged by Midland blast-furnacemen. Reports from the various branches of engineering which use pig iron do not reveal much increase in activity. Raw iron sells at the fixed rates laid down by the Central Pig Iron Producers' Association. Northamptonshire blast-furnacemen do not appear to be doing so well in the Northern and Scottish markets. Furnace coke is firm in value and local smelters do not experience difficulty in getting adequate supplies.

Coventry Monoplanes for Imperial Airways.

Imperial Airways, Ltd., has ordered from Armstrong, Whitworth Aircraft, Ltd., of Coventry, a fleet of eight four-engined monoplane air liners to provide an express air mail service between London and Cape Town. The new machines will, it is stated, be the largest monoplane air liners ever built in Britain. They are each to be fitted with four specially supercharged Armstrong-Siddeley engines of 340 horsepower and they will be designed for a speed of 145 miles an hour. The engines will be placed out on the wings away from the body, and the wings and body will be made entirely of strip steel. I understand that hitherto all British air liners have been of biplane construction.

Guest Keen's Trading.

In explanation of the decision to defer consideration of the payment of a dividend on the second preference shares until April next, Guest, Keen and Nettlefolds, Ltd., state that trading conditions throughout the half-year ended September 30th last became progressively worse. Operations during that period resulted in a profit, but at a decreased rate compared with the previous year. It is added that business in many departments now shows a tendency to improve, but it is not yet certain that the improvement can be consolidated at home and abroad. Shareholders in the company are trusting that the improvement spoken of will continue and that the directors will find it possible when the accounts are completed in April next to recommend the payment of a full year's dividend.

Fuel Shortage in the Potteries.

In my letter of September 4th I referred under the above heading to the difficulties which had arisen in North Staffordshire owing to the pottery manufacturers being unable to get sufficient coal for their needs from the colliery owned by a syndicate of pottery firms. The situation was caused by the colliery having raised to the surface its quota of coal, and it resulted in the closing down of the pit for several days in August, September, and October. Not only so, but in August 2500 pottery operatives were rendered idle and these troubles were likely to recur. I stated that efforts were being made to prevent a repetition of such difficulties, and now an award of arbitrators has granted an increased quota of 30,000 tons, bringing the annual standard tonnage to 220,000 tons to the colliery concerned—the Wolstanton Colliery, Stoke-on-Trent. In circles concerned it is stated that the increase may prevent further stoppages of work at the end of each month, but it is still doubtful, with an improvement already observable in the pottery trade, whether it will be sufficient to supply the entire requirements of the firms which rely upon the colliery for fuel.

Works Extensions.

A Darlaston firm of bolt and nut manufacturers is evidently anticipating a considerable improvement of trade, for it has decided to erect additional workshops. The works extension which is to be carried out at the premises of C. Richards and Sons, Ltd., is said to be costing something like £10,000. It is satisfactory to hear that the necessary steel work is to be supplied by a Darlaston firm. Another local works is also reported to be contemplating extension of its works.

Miners' Wages.

While hewers of coal in many districts have had reductions of wages, this month miners in the Warwickshire coalfield are to receive remuneration for their labour on the same basis as during the month of October, namely, 46 per cent. above pre-war standard.

More Employment in Birmingham.

The steady re-absorption of employees into Birmingham industries continues. During the past six weeks there has been a big decrease in the number of registered unemployed, the total having fallen from 74,872 to 67,661. The present total is made up of 47,094 men, 18,548 women, 1398 boys, and 621 girls. Unemployment is greater by 15,484 than it was a year ago, but whereas at this time twelve months ago the figures were mounting, they are now steadily declining. All the manufacturing towns in the Birmingham neighbourhood this week show improved conditions, while there has been a substantial decline in the number of workless in the Stoke-on-Trent area.

Obituary.

It is with regret that I have to record the death, as a result of an accident, of a well-known Midland ironmaster in the person of Mr. Norman W. Kidner, of Kettering. For a number of years Mr. Kidner had managed the Islip blast-furnaces, succeeding his father in that position. He was a familiar figure on the Birmingham Coal and Iron Exchange, members of which express deep sympathy with his widow, sons and daughters. Deceased was sixty years of age.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Steel Corporation Developments.

SATISFACTORY progress is being made with the important scheme of developments which the Lancashire Steel Corporation, Ltd., is carrying out at its works at Irlam, near Manchester. When completed, the scheme will have cost altogether something like £1,250,000, and the works will have plant and handling equipment which will entitle it to rank among the most efficient in the country. Mr. J. Sinclair Kerr, a director of the Steel Corporation, does not expect the work of reconstruction to be completed until early in 1933. The important features of the scheme are the erection of a new coke oven plant with an output capacity of between 5000 and 6000 tons a week, together with extensive by-product plant, new blast-furnaces and rolling mills, and, in conjunction with the Manchester Ship Canal Company, the construction of a new 600ft. dock to facilitate the import of iron ore and other raw materials and the export of finished products. The erection of the coke oven plant was started at the beginning of July. Mr. Sinclair Kerr this week expressed confidence in the success of the reconstruction scheme. He stated that more than 5000 men are employed at the Steel Corporation's works, and that all sections are working fully.

Lining the Mersey Tunnel.

After work which has been in progress for nearly six years—an actual start was made in December, 1925—the new Mersey Tunnel, running from Liverpool on the Lancashire side of the river to Birkenhead on the Cheshire side, may now be said to be within measurable distance of becoming a finished product. It has been a huge undertaking, capable of taking four lines of traffic on its upper roadway, and the cost in round figures is put at £5,000,000. On grounds of economy, the task of lining the inside of the tunnel has created a last-minute hitch. For a long time a number of firms were experimenting over small sections of the tunnel with lining surfaces of various types, and simultaneously severe laboratory tests were being carried out as to the effect of atmospheric influences on the materials suggested. Eventually, the Tunnel Committee proposed the use of a glass lining in 14ft. panels, but the Ministry of Transport has now stepped in with the request that a cheaper material should be employed. It is understood that investigations with this end in view are being speeded up.

Electricity Costs in Fifteen Years.

A cheapening of the average cost of electric current to the consumer by about 35 per cent. within the next ten or fifteen years was predicted by Mr. L. Romero, the city electrical engineer of Salford, in an address before the North-Western Students' Section of the Institution of Electrical Engineers. Mr. Romero based this prediction upon a consideration of the economies in generation and distribution, resulting from a steady improvement in the load factor in consequence of the rapid expansion of the demand for current for both industrial and domestic purposes.

The Industrial Outlook.

Further evidence of some degree of improvement in Lancashire engineering has been forthcoming since last week. Boilermakers are not generally busier, but in the case of one of the leading firms, it is stated that there has recently been a remarkable improvement, in both the boilermaking and constructional sections of the business. Another local concern reports substantial contracts for machinery for the rubber and canning industries, and more than one Lancashire firm widely interested in heavy oil engines has plenty of work in hand, largely through the recent extension of the field of application to road transport. Henry Simon, Ltd., of Cheadle Heath, near Manchester, has secured an order from the Leith Harbour and Docks Commissioners for machinery and equipment for a new 25,000-ton granary. Some of the larger concerns have not so far experienced any very marked improvement, but it is understood that quite a number of small works are appreciably busier than they were two or three months ago.

Non-ferrous Metals.

Since my last report, and more particularly during the early days of the present week, there has been a pronounced upward movement in all sections of the non-ferrous metals market, and with the exception of copper, values have touched higher levels than at any time this year. In the case of tin, although the statistics for the past month were not up to expectations, the position, from the point of view of supply and demand in the near future, is regarded more hopefully, and it is largely on the strength of this that speculative buying interest in the metal has expanded. The demand from consumers in this country, although somewhat better than it has been, has not been sufficient to have much effect on values, and sales both in the United States and on the Continent are far from satisfactory. In the meantime tin is dearer on balance by about £5 a ton. Inquiry for copper has expanded a little here, and in America, and the growing hope of a successful end to the negotiations on output curtailment has had an important influence, standard brands moving up by about £3 a ton. An improved statistical position in respect of lead, coupled with a more active demand for the metal, has sent up quotations by about £1 5s. a ton, and partly in sympathy spelter is dearer compared with a week ago by 15s.

Iron and Steel.

Although not higher relatively to the contract orders placed during the past month or so by Lancashire foundries, deliveries of pig iron into consumption locally undoubtedly represent an improvement, and somewhat bigger quantities are being taken by machine tool makers, certain textile machinists, and manufacturers of speciality products. Midland makers of pig iron are receiving odd orders for delivery over the early months of next year, but at the moment there is no general anxiety to buy, the majority of users being well covered for the time being. Staffordshire, Derbyshire, and Cleveland brands are still quoted at 67s. per ton, delivered equal to Manchester, Northants at 65s. 6d., Scotch makes at about 87s., and West Coast hematite at 81s. Bar iron is moderately active at £9 15s. for Lancashire Crown material, and £8 5s. for seconds. The demand for constructional steel locally remains slow, but there has been rather more doing in plates, with a fair business passing in bars. Values are firm but unchanged generally. In the market for continental materials only moderate orders are being booked at the moment, with merchant interests in many cases in a position to undercut the mills, owing to favourable contracts placed some time ago.

SHEFFIELD.

(From our own Correspondent.)

Statistics of Production.

THE detailed figures of steel production in September are now available. They relate, of course, to a period prior to any improvement in trade that may have resulted from the formation of the National Government, and they do not show any signs of progress, but rather the reverse. As previously reported, a few more furnaces have been brought into operation during the last few weeks, so that it may be hoped that the October figures, when they come to be published, will show a gain, though it is not likely that that gain will be a very large one. As to September, the output in Sheffield and on the West Coast amounted to 61,600 tons, as compared with 67,900 tons in August and 75,700 tons in September of last year. An unusually large proportion of the output was basic steel, the quantity of acid steel included in the total being below 20,000 tons. Lincolnshire showed some progress

in September, its figure being 30,100 tons, as against the 22,100 tons of August, but it was seriously below the 65,700 tons of September, 1930. In the same district the September output of basic pig iron was 31,000 tons, as against 30,800 tons in August, and 56,400 tons in September last year.

State of Trade.

Taking the steel trade as a whole, there is no particular increase of activity to record. Production of open-hearth steel remains at recent levels, but in the heavy section of the rolling mills, the improvement which followed the suspension of the gold standard has not continued, and a return to quiet conditions has been experienced. The exchange position is affecting a good many of the more finished lines, and in them increased business is being done. There is a general feeling of confidence in the future. The scrap market is firm, merchants valuing basic steel scrap at 42s. per ton. Although continental crude steel is still being imported, comparatively little is being ordered for future delivery. The heavy manufacturing departments and the special branches show little change.

Armaments and Nationalisation.

The armament plants of the city are slack, the amount of work now coming to them having shrunk to a mere shadow of former proportions, and the question of maintaining the plants, in the national interest, has again been brought forward. Speaking at Vickers works last Friday, on the occasion of the visit of the Master Cutler and his guests, Lord Falmouth—chairman of the local board of the English Steel Corporation—emphasised the dangerous situation in which the country would find itself if an emergency arose and the armament plants were not in a position to supply the demand for warlike materials. It seemed to him impossible to expect the shareholders of the armament companies to keep great plants doing nothing for a possible opportunity that, some time or other, there might be a demand for their products; and he thought that it was a matter of great importance that our leaders should take the facts into consideration and face up to the position of what would happen in an emergency. Lord Falmouth also referred to the question of nationalising the steel trade. In these days, he said, there were dozens of people giving advice to the trade, and the more advice they gave the more one began to understand that they knew nothing whatever about it. The Sheffield steel trade, in particular, was one of the most complicated trades in the country, and he was perfectly certain that, no matter how brilliant or how clever Government officials were, no system of nationalisation could ever run the steel industry in Sheffield. It had been built up by private enterprise, by the courage and foresight of private individuals, and it was only by encouraging private individuals to carry on their work that the steel trade would be able to maintain the wonderful position that it had achieved during the last hundred years.

A Great Machinery Hall.

The new Master Cutler is Mr. Joseph Ward, chairman of the firm of Thos. W. Ward, Ltd., and, when his guests went round the Vickers works on the day after the Cutlers' Feast, they saw many interesting operations in process. The manufacture of special steel for aircraft and motor purposes is carried on at these works, and Mr. Ward, speaking at a luncheon which followed the tour, gave some striking details of the great extent to which the firm had supplied vital parts to machines which had established world records on land, in the air, and on the water, including the seaplanes which won the Schneider Trophy this year, "Miss England II.," and Sir Malcolm Campbell's "Bluebird." The Master Cutler's guests also paid a visit to the works of his own firm, where special objects of interest were a great machinery hall which has been recently completed, for the display of reconditoned machinery, and extensive additions to the office accommodation. The machinery hall measures 194ft. long by 91ft. wide, and is 38ft. high. It is served by two travelling cranes, one of 35 tons and the other of 10 tons. At present it is occupied by about 750 reconditioned machines, most of them of large size, and including appliances suitable for all trades. The firm has large reconditioning shops on the site, and also a very extensive stock of new machinery. It has similar works in several other places, and the total number of machines which it has in stock at all its branches is about 15,000.

Sir William Ellis Retires.

Sir William H. Ellis, of Sheffield, an ex-President of the Institution of Civil Engineers, has decided to retire from his appointments with John Brown and Co., Ltd., and associated companies at the end of this year. Sir William started on his engineering career as apprentice to a Leeds firm fifty-three years ago. He has been connected with John Brown and Co. for forty-four years, and has occupied various positions from under-manager to managing director. In January he and Lady Ellis will leave England for some months, on a visit to New Zealand and Australia. Sir William is a member of a number of important bodies in Sheffield, and he intends to continue his public work. Another item of company interest just announced is that Sir Holberry Mensforth, K.C.B., G.B.E., has been appointed a director of Thos. Firth and John Brown, Ltd., and also of John Brown and Co., Ltd.

Cutlery and Plate.

The position of the cutlery and plate trade as a whole is much stronger than it was at this time last year, and prospects are good, though a good many old-established firms which do trade on ordinary lines complain of quietude and a lack of substantial orders for the Christmas season. The abandonment of the gold standard, however, has been followed by a considerable increase of activity in several branches. Neither the exchanges nor foreign competition affect the table knife department much, but in other sections there is a considerable improvement, owing to the fact that the difference in the exchange is equivalent to a tariff of 25 per cent. on German goods. There are still stocks of German tools, scissors, and certain classes of knives in this country, but they are nearing exhaustion, and are not being replenished. The overseas demand for cutlery is poor. There is a good demand for cheap electro-plated goods in cases, which is bringing much work to small firms. One of the branches which has gained most by the new monetary conditions is that of scissors. Orders on hand to-day are quite double the volume of any recent record, and there is promise of continuous activity. In recent years, Sheffield firms have shown much enterprise in improving their methods of scissors production, and laying down new plant, and that is another factor which has led to a recovery of trade that has been allowed to drift to Germany. Orders for scissors amounting to nearly 130,000 pairs have recently been booked by Champion and Co., of Broad-lane, Sheffield, and at least one of these orders would have gone to Germany if the firm had not been able, by means of labour-saving methods and excellent organisation, to quote favourable prices. George Wostenholm and Son, Ltd., of Washington Works, Sheffield, have recently put down a plant for plating scissors with chromium, thus making them stainless, while the cutting properties of the carbon steel are retained, and several patterns and sizes are now on the market.

Good News from Doncaster.

A revival is reported in several branches of trade at Doncaster. The Doncaster Wire Works has resumed full-time working, largely owing to the receipt of orders from America and Russia, and are now finding employment for 330 men and 40 women. The textile mill of G. Anderton and Son, Ltd., which had suffered severely by the slump, is also on full time again, finding work for over 200 people; and there is a great improvement in the local glass trade. The Doncaster Corporation has received several inquiries from large industrial concerns for factory sites.

Grimsby Dock Progress.

Work in connection with the new fish dock at Grimsby, which is to cost £1,500,000, has now been in hand for twelve months, and good progress has been made. As a preliminary to the construction of the dock itself, a huge embankment is, as our readers are aware, being built, by which a large area of land will be reclaimed from the river Humber. Already over 150,000 tons of chalk have been used in the building of this embankment. Each day four trains arrive from the chalk quarries at Brocklesby, each laden with 300 tons of chalk, for the work. The face of the river wall is being made of concrete blocks each weighing a ton, and this work is being pushed forward as rapidly as possible in order to prevent heavy seas from damaging the bank of chalk. It can only be undertaken at low water, but 140 of these ton blocks are placed in position every twenty-four hours.

Municipal Schemes.

In view of the call for economy, the Notts. County Council has decided to defer schemes of road improvement, estimated to cost £424,200. Several schemes are to be proceeded with, however, including the new Nottingham–Bawtry road—estimated cost, £214,800—the Mansfield Woodhouse–Edwinstowe–Ollerton road—£15,175—and the Nottingham–Melton road—£67,300. Work has been started in connection with the building of the new Town Hall at Barnsley, for the superstructure of which a tender amounting to £147,000 was recently accepted, but it is understood that the tower, which was to have cost about £10,000, is to be dispensed with, and that the Town Council will consider what other economies can be brought about. At Dewsbury the Corporation has just completed a widening of Thornhill-road and the erection of a new bridge to carry it over the canal. The bridge, which is 45ft. wide, with a carriageway of 30ft. and two footpaths of 7ft. 6in. each, replaces a narrow, single skew-arch bridge which was built about 1795. The Clowne Rural District Council has decided to carry out alterations and improvements to the sewage works in the parishes of Clowne, Creswell, Whitwell and Barlborough, and to provide an additional unit at Hodthorpe pumping station, at an approximate cost of £15,500. At Whitby, the Urban Council has decided to proceed with the continuation of the sea wall to Happy Valley, at an estimated cost of £8400, in order to provide work for the unemployed.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Merger.

NEGOTIATIONS for the formation of another North-East Coast iron and steel merger have reached a more or less definite stage. If effected, it will constitute the largest iron and steel combined in Great Britain. The capital involved approaches £40,000,000 and the yearly output capacity of the combined firms will be in the neighbourhood of 4,000,000 tons of steel alone. The firms interested in the project are Dorman, Long and Co., Ltd., who two years ago absorbed Bolckow, Vaughan and Co., Ltd.; the Furness group, which controls the Cargo Fleet Iron and Steel Works and the South Durham Iron and Steel Works; Pease and Partners, who own the Skinningrove Iron and Steel Works; and the Consett Iron Company, Ltd. It is expected that the fusion will be satisfactorily completed by the beginning of next year. Rationalisation has long been urged as essential to the recovery of the iron and steel industry, and many manufacturers have contended that it could not be successfully achieved without protection of the home market. Now that the country has arrived at the point of conversion, it is generally claimed that rationalisation would effect a marked improvement in the industry in all directions. The National Federation of Iron and Steel Manufacturers recently pointed out that "the future of the industry tended towards regional organisation based on amalgamation of similar interests," and that it would "ultimately attain regional dimensions with a co-ordinating object of formulating a direct national policy in, for example, such matters as the development of market and international negotiations."

Cleveland Iron Trade.

Although actual business matures somewhat slowly, inquiries are steadily becoming more numerous for Cleveland pig iron, and an encouraging view is taken of the outlook. There was a rush of covering purchases when the gold standard was first abandoned, and any substantial expansion is now dependent upon increased industrial activity. In this direction the position is improving, but the improvement is very slow, and consumers having covered the bulk of their present needs are in no hurry to make fresh purchases. There are, however, a few forward inquiries circulating. A strong point is the fact that stocks are being reduced and will soon represent no more than a normal trading margin. Prices are steady and firm, No. 1 Cleveland foundry iron being 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

Further sales of East Coast hematite pig iron are reported to Sheffield and Midlands consumers, and merchants are doing a small export trade. Producers quote on the basis of 66s. for ordinary qualities, but buyers state they can cover needs on rather lower terms. No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

There is no fresh business in the foreign ore trade and sellers' quotations range round about 17s. 3d. for best Bilbao Rubio, c.i.f. Tees. Durham blast-furnace coke is in little demand, as local consumers manufacture for their own requirements. Good average qualities range from 17s. to 17s. 6d. delivered at the works.

Manufactured Iron and Steel.

Business generally is quiet in the manufactured iron and steel trade. Producers of heavy constructional materials have still a good deal of work in hand, but in other departments of the industry new orders would be welcomed. There has been a marked falling off recently in the demand for galvanised sheets, despite the fact that quotations have been lowered. Both home and export business is very weak, and mills are only with great difficulty maintaining their rolling programmes. An interesting feature this week has been a shipment of 4100 tons of steel to Canada.

The Coal Trade.

A much larger volume of inquiry is circulating in all branches of the Northern steam coal trade. This gives the market a more animated appearance, but operators are anxious to secure definite bookings. Sterling values are, of course, favourable to continental buyers. Merchants are, however, well aware of the extensive stocks of coal lying at all centres on the Continent, but are hopeful that present low values will tempt them to lay in further stocks. The home trade demand for steam, gas, and household coal is much below the average for this period of the year, and this tends to dull the outlook. However, during the last few days vessels have been sent to load for South Country ports, so that it only wants a spell of cold weather to brighten up that section of the trade. Household coals are firm and best Northumberland steams are offered in goodly volume at 13s. 6d. both for prompt and forward. Second-hand holders do not hold any large quantites, but they have to make slight concessions to clear their commitments. Prime Wear large steam are quietly steady, but readily obtainable at 15s.; Tyne primes are quoted at 13s., and Hastings and similar at 12s. to 12s. 6d. For small steams there are no signs of any improvement, and prices remain easy at from 8s. 6d. to 9s. The recent demand for best unscreened bunkers is well maintained, full output being readily taken up at 13s. 9d. to 14s., but shipowners make a stand against paying any higher figure. Secondary bunkers are in ample supply and weak in tone at 13s. to 13s. 3d. Owing to the continued mild weather and the consequent lessened consumption of gas coals, idle time at Durham pits is fairly common. All grades would welcome more business. Best qualities are quoted at 14s. 6d. to 14s. 9d., and seconds are easy at 13s. 6d. Keen pressure for gas coke is absorbing all current production, and makers have to draw upon accumulated stocks to meet the present commitments. Best qualities are scarce and firm at 19s. Patent oven coke is plentiful and moving slowly at weakly held values—16s. to 17s. For superior makes 18s. to 20s. is asked.

SCOTLAND.

(From our own Correspondent.)

Brighter Tone.

A BRIGHTER tone is noticeable in the steel and iron market. This change of attitude is not due to an increase in business, but rather to the fact that recent events have induced a broader view of the situation generally. The growth of the inquiry appears to justify a more hopeful outlook, even although actual business has not yet benefited to any extent, and the feeling is further strengthened by signs of returning activity in the Far East.

Steel.

Meanwhile it cannot be said that the steel industry shows improvement. As a matter of fact, orders are more scarce than ever. Two of the largest works in the West of Scotland are closed down and employment at the others only amounts to about 25 per cent. of the capacity. Producers are hopeful, however, that shipbuilding demands will soon show the long-looked-for expansion, to the benefit of sections and plates, which have been poorly specified

for a long period now. The improvement in sheets is maintained. Makers have recently booked a larger volume of business, and one concern at least is running full time, and will soon be fully occupied in the galvanising department also. Owing to the devaluation of sterling, British makers are able to meet German and Belgian competition in overseas markets, and orders from the East and Far East have improved in volume, especially for thin gauges. No improvement is reported from tube makers. Small-diameter butt-welded tubes are particularly quiet, and, though business in large tubes has increased of late, the actual turnover is still far from satisfactory. Better inquiries have come to hand which may bear fruit, but on the whole the outlook is dull. Steel prices generally are unchanged.

Iron.

In all departments of the Scottish iron trade new business is urgently required. Bar iron is barely moving and outputs are greatly curtailed. Re-rolled steel bars are in a much similar position, business having become even quieter since the price of raw materials from the Continent became dearer and the quotation for re-rolled bars was advanced to £6 10s. per ton, home or export.

Pig Iron.

The demand for hematite and foundry iron continues light, and the output from the three furnaces in blast is still sufficient to cover requirements. Last week two cargoes arrived in the Clyde from Millom, totalling 1300 tons, while shipments from the Clyde only amounted to 249 tons—215 tons to foreign destinations.

Scrap.

The recent advance in scrap is fully maintained, cast iron machinery being quoted 53s. and heavy steel scrap 40s. per ton.

Coal.

The export demand for Scottish coal continues to decrease. Colliery quotations have appreciated and Polish competition has become more intensive. As a result shippers have again to confine their attentions to prompt or early shipments, nothing in the way of long-term or speculative business being possible. The strongest feature of the market is still the position of washed treble nuts, especially Fifeshire sorts. Doubles are firmer and singles are inclined to firm up. Fifeshire steams, both first and third-class, are more scarce, but Lothians steams and Lanarkshire splints are quieter, though fairly steady in price. The aggregate shipments amounted to 237,638 tons, against 253,292 tons in the preceding week and 239,981 tons in the same week last year.

Shipbuilding Contract for Burntisland.

An order for a 7000-ton cargo steamer has been placed with the Burntisland Shipbuilding Company, Ltd., on behalf of London owners. The new vessel will be of the "Economy" type.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

From the point of view of the working of collieries last week was one of the worst for a very long time. Owing to the extremely bad weather which prevailed, tonnage was very much delayed and, as the result of steamers getting out of position, numerous undertakings were unable to work with anything like regularity. The figures supplied by the G.W.R. Company relating to the shipments at the docks under its control reveal only too plainly the adverse effects of the gale and the non-arrival of tonnage. The total of 361,620 tons was the worst since January, that is, excluding holiday periods, and compared with 438,180 tons for the preceding week and with 478,070 tons for the corresponding period of last year. On Saturday last the number of idle tipping appliances at the various ports reached forty-five, but week-end arrivals of steamers meant that on Monday there were only twenty-two idle appliances. Still, tonnage has not come along at all satisfactorily, and on Tuesday the number of idle appliances was back to thirty-eight, so that the prospect of shipments for this week are not at all likely to show a complete recovery. While the tone of the coal market remains better, still the fact remains that prompt business is not sufficient to create real activity in the steam coal section; but it must be admitted that for next year the outlook is more promising. A fair amount of business has been done ahead. From all accounts the Midi Railways of France, which were reported to have bought supplies of steam coals from this district, have made their purchases from Germany, but the Compagnie Générale Transatlantique has bought about 60,000 tons of large coals for delivery over next year; the British Admiralty has sent out a supplemental inquiry for 35,000 tons of coal and coke for its various depôts; there is an inquiry for 100,000 tons of bunker coals for Greece, to be delivered over 1931; the London County Council has asked for prices for 40,000 tons of large and sized coals for delivery next year, and it is expected that very shortly the Brazilian Central Railways will be in the market for supplies for delivery at the end of this year and in the early part of next.

Traffic Returns.

The statistics issued by the Great Western Railway Company of the traffic at the docks in this area under its control show that the figures for the four weeks ended October 25th compared favourably with those of the preceding month. Imports and exports combined came to 2,190,674 tons, made up of imports 291,751 tons and exports 1,898,923 tons, whereas for the preceding four weeks imports and exports together came to 2,071,975 tons, made up of imports 247,547 tons and exports 1,824,428 tons. For the whole of this year to October 25th imports and exports aggregated 22,684,814 tons, which compares with 29,250,853 tons for the same period of 1930, so that there has been a falling off of no less than 6,566,039 tons. Exports alone fell off by 5,706,184 tons, and imports by 859,855 tons. Coal and coke shipments declined to the extent of 5,194,250 tons.

The Bid for Industrial Expansion.

The chief feature of the proceedings accompanying the election of the chief magistrate at all leading centres in this district on Monday was the optimistic outlook and the announcements which were made regarding the activities of the various development undertakings to attract fresh industries. At Cardiff the need was stressed for the introduction of new industries, and one inquiry, which has been received by the Chamber of Commerce, is from a Bohemian manufacturer of viscose foils, otherwise known as cellophan, cell glass, &c., with the view to the establishment of a factory at Cardiff or in the district. Swansea is making a strong bid for the expansion of its trade and has had numerous inquiries for sites, including one from an American firm, two from continental chemical firms and a continental manufacturer of sheet metal goods and novelties. The Swansea Corporation is the biggest landowner in the borough and has prepared a comprehensive plan showing no fewer than sixty-two sites, varying from 2 acres up to 100 acres, suitable for works and factories.

More Work.

Notices which were issued to 1500 men and officials by Llewellyn-Nixon's Colliery Company at the Cwmcynon Pit, Mountain Ash, more than a fortnight ago, were withdrawn and the men resumed work on Monday on day-to-day contracts. After a stoppage of eight days the management of the Ocean Western Colliery, Nantymoel, informed the 1000 men employed that full work would be resumed on Monday. The Dafen Sheet Works also reopened on Monday. This undertaking, which had been closed down since the beginning of the year, comprises four mills and employment is provided for close upon 300 men. At the end of last week it was announced that the notices to terminate contracts given by the 800 miners employed at the Bedwas Navigation Colliery had been withdrawn, and that another effort is to be made by negotiation to effect a settlement of the differences prevailing. The dispute arose as the result of the dismissal of certain men and the alleged failure of the company to carry out the agreement which was come to in July last.

Increasing Imports.

Reference was made recently to the activity prevailing in the import section of trade of this district. It is partly attributable to the expediting of deliveries of steel billets, bars, &c., chiefly from Belgium, in case the Government takes measures to restrict such activities, and partly to seasonal operations in the way of increased imports of toys, novelties, &c. Up to October 25th importations of foreign iron and steel amounted to 616,681 tons, of which Newport received 395,810 tons, Cardiff 82,036 tons, Swansea 77,810 tons, and Port Talbot 61,024 tons. Imports have averaged about 15,000 tons per week for the past year, but it is significant that during the past fortnight there has been an appreciable increase. For the week ended October 27th the total came to 30,237 tons, and for the week ended November 3rd the aggregate for all ports reached 38,363 tons.

Canada's Welsh Office to Close.

The news that, for reasons of economy, the Canadian Government intends to close the Welsh office at Cardiff has occasioned considerable disappointment in the Welsh metropolis, and hopes are entertained that the decision will be reconsidered. It is true that the office was established primarily for emigration purposes, but it is pointed out that, in view of the efforts to increase trade between this country and Canada, the office could be of considerable service in promoting trade.

Death of Miners' Leader.

The death on Sunday last at Cardiff of the Right Hon. Thomas Richards, ex-president of the Miners' Federation of Great Britain and general secretary of the South Wales Miners' Federation, although not unexpected in view of his ill-health for some months past, nevertheless was received with genuine regret in coal trade circles. He was recognised as an invaluable servant of the miners, moderate in his views, level-headed and wise in his counsel. He was seventy-two years of age and a native of Beaufort, Monmouthshire, where he began work as a collier's boy.

Current Business.

Although there is not a great deal of new business on the market for prompt loading, inquiries are coming forward and the general tone is maintained. Large coals for early delivery display irregularity. Dry qualities are firm and meet with a steady demand, but other descriptions can be secured without difficulty. Sized coals preserve a fairly good tone, particularly dry nuts, but smalls are plentiful. Coke moves more freely, but there is not much fresh activity in patent fuel. Pitwood shows no new feature and remains about 24s. to 24s. 6d.

Latest News from the Provinces.

LANCASHIRE.

Barrow-in-Furness.

Hematite.

There is nothing fresh to report about the hematite pig iron market. The improvement which was reported a few weeks ago is maintained, and there has been more business, but there were some who were too optimistic as to the general trend, and, in their imagination, had disposed of the heavy stocks which existed. Much of those stocks remains to be cleared yet, although a certain tonnage has been covered and awaits dispatch to customers. Foreign business is not heavy, for the simple reason that neither Continental nor American requirements at the present time are great. The iron and steel quietness is general, and not confined to this country. Better qualities of iron are selling best. Iron ore is in a little better demand, both on local and general account, but there is still much room for improvement. The steel trade is still quiet, and although another contract or two has been booked, the rail department at both Barrow and Workington would welcome further contracts. Hoops and small sections are experiencing a fair trade. Shipbuilders need fresh orders. Rumours are busy, but locally official news is eagerly awaited, for there is little work on the stocks.

LAUNCHES AND TRIAL TRIPS.

Imperial Transport, oil tanker; built by Blythswood Shipbuilding Company, Ltd., to the order of Empire Transport Company, Ltd.; dimensions, 460ft. by 60ft. by 34ft. 6in.; to carry oil in bulk. Engines, oil, "North-Eastern" type; constructed by the North-Eastern Marine Engineering Company, Ltd.; trial trip, September 10th.

Cardium, twin-screw oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Anglo-Saxon Petroleum Company, Ltd.; dimensions, 450ft. by 62ft. by 34ft.; to carry oil in bulk. Oil engines of Hawthorn-Werkspoor type; constructed by R. and W. Hawthorn, Leslie and Co., Ltd.; launch, September 15th.

Karabagh, oil tanker; built by Blythswood Shipbuilding Company, Ltd., to the order of Baltic Trading Company, Ltd., of London; dimensions, 425ft. by 57ft. by 32ft. 3in.; to carry oil in bulk. Oil engine; constructed by J. G. Kincaid and Co., Ltd., Greenock; trial trip, September 17th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mr. Arthur L. Tester has been appointed representative to Spurr, Inman and Co., Ltd., boilermakers and engineers, of Wakefield.

Mr. P. F. Rowell, the Secretary of the Institution of Electrical Engineers, was, at a meeting of La Société Française des Electriciens, specially convened for the purpose, made an Honorary Member of that body.

"R.N." Diesel Engine Company, of 24, Harrison-street, London, W.C. 1, has been formed to take over the sales, advertising and service of "R.N." Diesel Engines for which it is claimed that they are of British design, British materials and British-built.

CONTRACTS.

Redpath, Brown and Co., Ltd., of 3, Laurence Pountney-hill, E.C. 4, have received the order for the steelwork for the Glyn Mills Bank in Lombard-street, E.C. The tonnage involved amounts to 2000 tons.

C. A. Parsons and Co., Ltd., of Newcastle-on-Tyne, recently received an order for a 12,500 kW turbo-alternator for Pretoria, South Africa, and for two of its Uniplane turbo-generators for China. These machines bring the turbine plant now in hand at the Heaton Works to an aggregate of 257,500 kW, of which 90,750 kW are on foreign account.

W. T. Henley's Telegraph Works Company, Ltd., has received an order from the Central Electricity Board for the supply and erection of 43 miles run of three and six 1 square inch steel-cored aluminium conductors on lattice steel towers for a working pressure of 33,000 volts. This is an extension to the order for the South-East England scheme, which was placed with the same firm last year and on which work is now proceeding.

Peter Brotherhood, Ltd., of Peterborough, has received from John Brown and Co., Ltd., the order for two air compressors for the new 72,000-ton ship being built for the Cunard Line. The machines are to be of the firm's latest two-crank, single-stage, double-acting type, each delivering 300 cubic feet of free air per minute at 120 lb. per square inch when running at 415 r.p.m. They will be driven direct by 70 H.P. Laurence Scott motors with automatic electric control gear.

Congrès International d'Electricite de 1932.—The Institution of Electrical Engineers has set up a National Committee to organise the British effort in connection with the Congrès International d'Electricité de 1932, which will be held in Paris in July, 1932. The object of the Congress is the celebration of the fiftieth anniversary of the first International Electricity Congress, which took place in Paris in 1881, when fundamental and far-reaching decisions regarding electrical units were arrived at.

An Anti-waste Exhibition.—A Conference on the Planning of Works and Factory Economy and an Anti-Waste Exhibition, which will be a graphic representation of methods of reducing waste, has been arranged in co-operation with member firms of the Industrial Welfare Society, is to be held at the Hotel Metropole, London, W.C. 2, to-day—November 13th. "Improving Value of Manpower in Industry" will be the subject of a lecture, given in the morning session, by Mr. P. M. Stewart, O.B.E., J.P. (chairman, Associated Portland Cement Manufacturers, Ltd.), and in the afternoon Mr. E. S. Byng, M.I.E.E. (managing director, Standard Telephones and Cables, Ltd.), will speak on "Waste of Material." There will be a luncheon at which Mr. W. W. Paine, director, Lloyds Bank, Ltd., will be the guest.

The Institution of Civil Engineers: Awards.—The Council of the Institution of Civil Engineers has awarded the Indian Premium for the Session 1930–31 to Mr. G. C. Minnitt, Assoc. M. Inst. C.E. (Bombay), for a paper read and discussed at an ordinary meeting of the Institution. It has also made the following awards for the Session in respect of "Selected Engineering Papers," published without discussion: A Telford Gold Medal to Mr. Herbert Addison, M.Sc., Assoc. M. Inst. C.E. (Giza, Egypt); Telford Premiums to Messrs. H. A. Sieveking, M.Sc., Assoc. M. Inst. C.E. (London), William Blackadder, D.Sc., Assoc. M. Inst. C.E. (Aberdeen), R. F. Legget, M. Eng., Assoc. M. Inst. C.E. (Montreal, Canada), and jointly to Messrs. R. G. C. Batson, M. Inst. C.E., and H. R. Mills (Teddington), and in respect of papers read at Students' Meetings in London, or by students before meetings of Local Associations, during the same Session: The James Forrest Medal and a Miller Prize to I. W. G. Freeman, and Miller Prizes to Messrs. V. A. C. Durand (Cardiff), F. C. Ball, T. A. Burnside, F. R. Paynter, D. H. McPherson, S. G. Barrett, E. H. Ely, and H. E. Orr, all students of the Institution.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/- to 20/6
(1) Spanish	17/- to 19/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	17/- to 17/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 6 0	3 6 0
No. 1	3 6 6	3 6 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
,, ,, Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (a) / 4 0 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
Lancs.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	9 0 0	8 10 0
,, ,, (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
,, (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	8 15 0 to 8 17 6	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars (all British)	7 12 6 to 8 0 0	—
Small Re-rolled Bars	6 17 6 to 7 0 0	—
Billets and Sheet Bars	5 7 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 7 6 to 9 15 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 17 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	13/6 to 14/3
Block Tin (cash)	134 5 0
,, (three months)	134 15 0
Copper (cash)	39 2 6
,, (three months)	39 15 0
Spanish Lead (cash)	14 17 6
,, ,, (three months)	14 16 3
Spelter (cash)	14 3 9
,, (three months)	14 12 6
Manchester—	
Copper, Best Selected Ingots	42 0 0
,, Electrolytic	43 5 0
,, Strong Sheets	72 0 0
,, Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
,, Condenser, lb.	0 1 0
Lead, English	16 12 6
,, Foreign	15 0 0
Spelter	14 7 6
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/-
,, ,, 6 p.c. to 8 p.c.	£24 0 0	7/-
,, ,, 8 p.c. to 10 p.c.	£22 10 0	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£36 0 0	10/-
,, ,, ,, 1 p.c. carbon	£42 0 0	12/-
,, ,, ,, 0·70 p.c. carbon	£50 0 0	13/-
,, ,, ,, carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
,, ,, ,,	£11 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£10 10 to £12 scale 5/- per unit	
,, ,, 75 p.c.	£16 to £17 scale 7/- per unit	
,, Vanadium	12/9 per lb.	
,, Molybdenum	4/2 per lb.	
,, Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£210	
Ferro Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	14/3 to 15/6
,, ,, Trebles	16/-
,, ,, Doubles	13/- to 13/6
,, ,, Singles	9/6
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	17/-
,, ,, Trebles	15/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 13/6
Screened Navigation	17/-
Trebles	16/6 to 18/6
Doubles	13/6 to 14/6
Singles	10/-
Lothians—	
(f.o.b. Leith)—Best Steam	12/6
Secondary Steam	12/-
Trebles	16/-
Doubles	13/6
Singles	10/-

(8) N.W. Coast— ENGLAND.

	Export.
Steams	22/-
Household	32/6 to 51/6
Coke	20/- to 21/-
Northumberland—	
Best Steams	13/6
Second Steams	12/-
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
Durham—	
Best Gas	14/6
Second	13/3
Household	25/- to 37/-
Foundry Coke	24/-

Sheffield—	Inland.	Export.
Best Hand-picked Branch	24/6 to 25/6	—
South Yorkshire Best	23/6 to 24/6	—
Derbyshire Best Bright House	21/- to 22/-	—
Best House Coal	21/6 to 22/6	—
Screened House Coal	19/- to 20/-	—
Best Screened Nuts	18/- to 19/-	—
Small Screened Nuts	16/6 to 17/6	—
Yorkshire Hards	17/- to 18/6	—
Derbyshire Hards	17/- to 18/6	—
Rough Slacks	9/6 to 10/6	—
Nutty Slacks	7/6 to 8/6	—
Smalls	5/6 to 6/6	—

Blast-furnace Coke (Inland) 10/6 to 11/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 16/- to 16/6

(9) SOUTH WALES.

Cardiff—	Inland.	Export.
Steam Coals:		
Best Smokeless Large	19/6 to 20/-	—
Second Smokeless Large	18/9 to 19/6	—
Best Dry Large	19/- to 19/6	—
Ordinary Dry Large	17/9 to 18/3	—
Best Black Vein Large	18/3 to 18/6	—
Western Valley Large	17/9 to 18/-	—
Best Eastern Valley Large	17/7½ to 17/9	—
Ordinary Eastern Valley Large	17/3 to 17/6	—
Best Steam Smalls	13/- to 13/6	—
Ordinary Smalls	11/- to 13/-	—
Washed Nuts	19/- to 26/-	—
No. 3 Rhondda Large	19/9 to 20/-	—
,, ,, Smalls	15/- to 16/-	—
No. 2 ,, Large	17/- to 17/3	—
,, ,, Through	15/6 to 16/-	—
,, ,, Smalls	14/- to 14/3	—
Foundry Coke (Export)	22/- to 36/6	—
Furnace Coke (Export)	15/6 to 17/-	—
Patent Fuel	19/- to 19/9	—
Pitwood (ex ship)	24/- to 24/6	—
Swansea—		
Anthracite Coals:		
Best Big Vein Large	36/- to 38/6	—
Seconds	27/- to 31/6	—
Red Vein	22/6 to 27/6	—
Machine-made Cobbles	41/6 to 43/6	—
Nuts	40/- to 43/6	—
Beans	28/6 to 32/6	—
Peas	21/- to 22/-	—
Breaker Duff	8/6 to 9/6	—
Rubbly Culm	8/6 to 9/-	—
Steam Coals:		
Large	20/- to 20/6	—
Seconds	18/- to 20/-	—
Smalls	11/6 to 13/-	—
Cargo Through	16/- to 17/6	—

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trade Outlook.

THE trade slump has the effect of increasing unemployment, which is accentuating every week, a fairly reliable estimate giving a total of 300,000, and this has awakened everyone to the necessity of taking urgent measures to arrest the depression by spending as much money as possible on productive works. But while this country has such a huge accumulation of gold, there is very little money available for commercial and industrial purposes, the banks being unable or unwilling to give credits. The scheme of public works will bring little relief to the engineering industries, except, perhaps, electrical engineering, which may benefit from the electrification works. Seeing that export markets offer little scope for business, the tendency is to make the most of home and colonial markets by monopolising them for French goods, which means that manufacturers favour higher tariffs that will protect more effectively home industries and will allow of greater advantages being obtained in future discussions with countries which are protecting themselves.

Coal Imports.

There is likely to be a further tightening of the coal import licences as the result of the efforts of the miners' representatives to impress upon the Government the necessity of doing something to prevent the closing down of pits in the Nord and the Pas de Calais. The spectre of unemployment is driving the Government to all sorts of measures to provide work, and the miners' representatives have put the situation in so lamentable a light that the licence system will be allowed to operate automatically and, perhaps, more rigorously than it would do otherwise in view of the tendency to reduce imports of all kinds as much as possible. The miners' representatives affirm that, in the Northern Departments and in the Saar, the stocks of coal have reached 5,000,000 tons, and that some of the pits are only working two days a week, but these figures apply more to the Saar than to the French collieries, which are not in anything like so bad a situation as they are said to be. The French colliery companies are, of course, suffering from foreign competition and the dwindling consumption of industrial coal; but probably nowhere is more being done in the way of reorganisation for the economical production and utilisation of coal, in cleaning and grading, installing generating stations for electrical distribution in which the steam generators are fired by dust from the coal screening plants, and in the production of ammonia and other products, some of which are, for the moment, a drug on the market. For the coal-owners it is either a question of further protection or wages reduction, and the men are therefore solid for protection and are responsible for the negotiations that have led to the institution of coal import licences. They say that the smaller consumption of industrial coals should be borne in the proportion of one-third by home collieries and two-thirds by coal importers. The restriction of coal imports is much resented by consumers, who say that the only remedy is to lower selling prices, and it is doing serious harm to the interests of shipping. The partial closing of the ports to coal contributed to the increased tonnage of French ships laid up during the third quarter of the year, the total being 590,835 tons, an augmentation of 24,053 tons on the previous three months.

Foreign Exchanges.

Now that possible import restrictions into Great Britain are causing so much anxiety to the French, it is instructive to observe the figures of foreign trade during the first nine months of the year, when the imports into France totalled 2947 million francs from Great Britain, 3096 millions from the United States, and 4764 millions from Germany. In all cases there was a heavy decline on the previous year. Germany owes her exceptional position as an exporter to this country to the amount of machinery and material of all kinds sent on account of reparations, but there is a considerable amount of business done independently of reparations, and largely on account of them, for the ports and public bodies continue to purchase German plant. By far the most valuable buyer of French goods and products was Great Britain with 3867 million francs, followed by Germany with 2172 millions, while the United States was fifth on the list with 1158 millions. Here again there was a heavy decline all round as compared with the previous year. Great Britain is the only country with a heavy trading balance against her, the adverse difference for the first nine months of the present year being 920 million francs, while in the similar period of 1930 it was 1279 millions. Seeing that all other countries trading with France have balances in their favour, it is comprehensible that the French should now be busy exploring the ways and means of keeping their best customer.

Machinery.

As British manufacturers of machinery have been able to reduce their prices in French currency by 20 per cent. they are now on a competitive level with other foreign makers, and the situation would be favourable to business if there were a demand for machinery. Not only has the slowing down of industrial activity reduced machinery requirements to a minimum, but there is on the market an enormous quantity of second-hand machines from Germany which would make conditions very precarious for home makers, even if trade were brisk. Local bodies have apparently been purchasing machinery and plant from abroad because prices are lower than they are in this country, for Monsieur Dalbrouze, President of the Fédération de la Mécanique, has sent a protest to all the Chambers of Commerce against this buying of foreign material when French makers can supply all that is needed. Apart from the fact that 900,000 hands employed in the mechanical engineering trades need all the work they can get in these times of stress, Monsieur Dalbrouze points out that there is no economy in saving money by purchasing foreign machines, because the State loses and French makers suffer in reputation.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

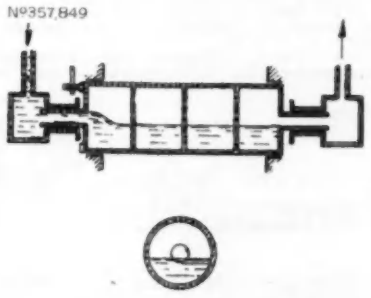
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

357,849. November 18th, 1930.—ROTATING STEAM GENERATORS, J. V. Blomquist and T. A. J. Blomen, Nackstromsgatan 2, Stockholm, Sweden.

This specification covers a development of the inventor's idea of using rotary water tubes in a boiler, with the object of increasing its steaming capacity. He points out that should such a boiler be used on a locomotive, the acceleration and

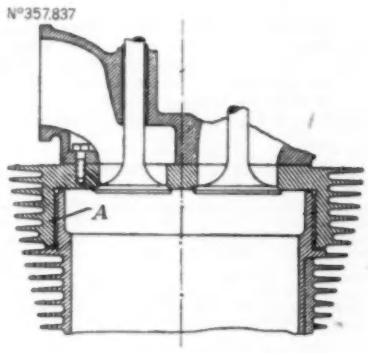


deceleration of the engine would result in the water surging up to one end or the other of the tube, leaving the other end dry, to its detriment under the action of heat. As a consequence, he arranges a series of diaphragms along the length of the tubes, with central perforations for the passage of steam and water, which prevent the total drying of any part of the tube.—*October 1st*, 1931.

INTERNAL COMBUSTION ENGINES.

357,837. November 11th, 1930.—AIR-COOLED CYLINDERS, Siemens and Halske Aktiengesellschaft, Berlin-Siemensstadt, Germany.

All this invention amounts to is the use of beryllium bronze for the cylinder head, on account of its good thermal con-

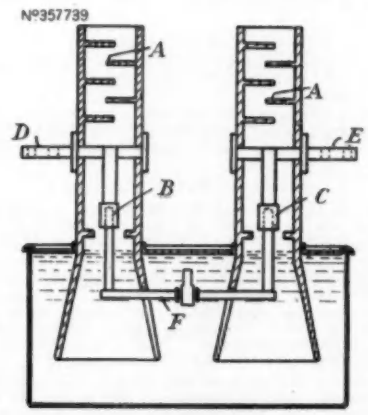


ductivity, and the superposition of a light metal alloy casting for the inlet and outlet ducts. The beryllium head A is screwed on to the steel cylinder body while it is warm, so that it may shrink in place. It is claimed that the arrangement permits the use of four valves with parallel stems.—*October 1st*, 1931.

SWITCHGEAR.

357,739. August 28th, 1930.—ELECTRIC SWITCHES WITH QUENCHING LIQUIDS, Voigt and Haeffner Aktiengesellschaft, of Hanauerlandstrasse 146–172, Frankfurt-on-the-Maine, Germany.

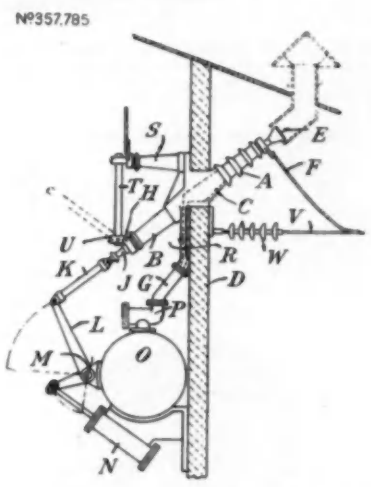
In the switch described in this specification contact takes place



above the surface level of a quenching liquid and within hollow projections, and the arc produced when the circuit is broken is drawn with the moving electrode into the liquid, so that the gases produced can easily escape in an upward direction. Both the hollow projections are provided with baffles A and have constrictions formed by annular transverse partitions close above the surface of the liquid. The stationary switch members B and C are in the form of sockets or sleeves, and are connected to the connecting members D and E. A switch cross bar F carries the movable electrodes or switch members, which are in the form of plugs or pins and enter the sleeves B and C. Owing to the fact that the switch members are so arranged that contact takes place above the liquid surface, and the arc that occurs upon switching off is drawn into the liquid, the removal of the vapours produced by the breaking of the circuit is facilitated, and a rapid quenching of the arc is at the same time obtained by the liquid cooling it. The vapours arising from the breaking of the circuit cannot, however, escape immediately through the hollow extensions, but are held back by the constrictions so that the pressure below the constrictions rises. A strong current of gases and vapours is therefore blown through the constrictions into the arc, and this assists its rapid extinction. The baffles A serve merely as a protection against liquid being splashed out, and for the cooling of the vapours that escape.—*October 1st*, 1931.

357,785. September 26th, 1930.—ELECTRIC SWITCHES OR CIRCUIT BREAKERS, Sigwart Ruppel, of 8, Palmengartenstrasse, Frankfurt-on-Main, Germany.

In accordance with this invention, switches or circuit breakers are arranged for the arc to be extinguished by gas under pressure, and the switch is constructed in the form of a lead-in bushing-type insulator. The parts A and B are mounted on the earthed middle member C, which is fixed on the wall D. The pillar A carries the nozzle contact E with the terminal F and opens into a gas exhaust or vent pipe which is led over the roof. The pillar B carries a cap H with the sliding connection J, which serves to convey the current to the movable rod contact which slides in it. The switch pin is actuated through an insulating

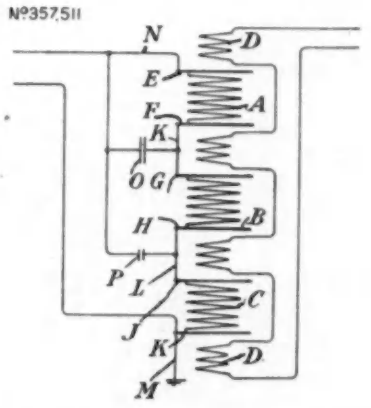


link K, lever L and shaft M from the drive N. The shaft may be common to all three phases. The pressure gas supply is obtained from the container O and is passed through a valve P, pipe G, pressure gas passage R, middle member C, and through the hollow pillar A to the point of interruption. The pillar S is arranged on the fixing flange of the earthed middle member C and carries the terminal of the isolating switch contact. The isolating switch blade T is pivoted in the isolating switch contact U which is fixed on the cap H. The drive of the isolating switch may be effected in any desired manner. In some cases the isolating switch may also be actuated from the driving device N. The incoming free lead V is strained at W and is connected to the terminal F of the pressure gas switch.—*October 1st*, 1931.

TRANSFORMERS AND CONVERTERS.

357,511. April 16th, 1930.—ELECTRIC TRANSFORMERS AND THE LIKE, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

The windings of transformers built in accordance with this invention are provided with electro-static shields for maintaining uniform distributions of potential in the windings. The high-voltage winding of the transformer includes three sections or groups of turns A, B, and C, interleaved with sections of a low-voltage winding D. The conductor forming the winding section A progresses uniformly across the space between two conductive end plates or shields E and F, which are connected respectively



to the two terminals of this winding section. The winding sections B and C are similarly arranged and connected between a pair of shields G and H and J and K respectively. Conductors K and L connect the shields F and G and the shields H and J respectively together to maintain the two shields of each pair at the same potential and to connect the three sections A, B, and C of the high-voltage winding in series between its earthed terminal M and its high-voltage terminal N. The two shields F and G are connected to the high-voltage terminals N through a condenser O, and the two shields H and J are connected to the high-voltage terminal through a condenser P. The principle of the scheme is fully described.—*September 16th*, 1931.

AERONAUTICS.

357,476. March 2nd, 1931.—LANDING GEAR FOR AEROPLANES, Fiat Società Anonima, 250, Via Nizza, Turin, Italy.

This landing gear is intended for use on snow-covered ground. The ordinary landing wheels of the aeroplane are removed, and

in their place are installed skis A—see Fig. 1—pivoted on the wheel axles, and held at the proper angle by elastic tie rods B B. The tail skid or ski—see Fig. 2—is supported by the strut C, and the elastic tie D, while the normal spring skid E rests on its

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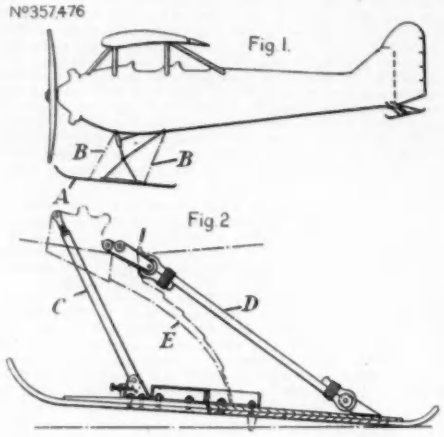

upper surface to carry the load. The essential feature of the invention is the provision of an adjustment in the length of the strut C, so that the ski can be set at an angle to suit the condition of the snow.—*September 24th*, 1931.

MEASURING AND TESTING INSTRUMENTS.

357,658. July 2nd, 1930.—THERMOMETERS, C. R. Palmer and C. P. Mitchell, 26, Clay-street, St. Bernard, Ohio.

In order to make a mercury thermometer easily readable, the inventor employs a system of reflected coloured light. The illustration shows a section through the stem of the thermometer tube. The bore for the mercury is marked A, and is approximately semi-circular in section. Behind it, embedded in the glass of the tube, there is a screen of white opaque glass

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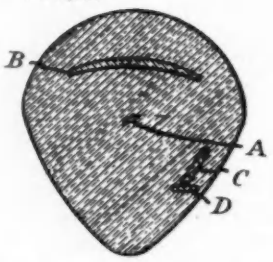

B to form a background. In front, and arranged at an appropriate angle, there is a strip of coloured—say, red—glass C, from which light is reflected on to the column of mercury. There is a screen D to prevent direct vision of the coloured strip, and the front of the tube is so formed as to magnify the image of the mercury. The result is that red light coming from the strip C is reflected from the flat face of the column of mercury and effectively defines its termination against the white background. —*October 1st*, 1931.

GAS PRODUCERS.

357,822. October 27th, 1930.—THE HYDROGENATION OF HEAVY ORGANIC COMPOUNDS, J. M. F. D. Florentin and A. J. Kling, 2, Quai du Marché Neuf, Paris, France.

Tar or such-like heavy hydro-carbon material is pumped into the reaction chamber A by the pump B. On its way it is heated up in the heat exchanger C and the primary heater D. Hydrogen is introduced through the heat exchanger E and pipe F. Assuming that the hydrogenation in the chamber A takes place at a

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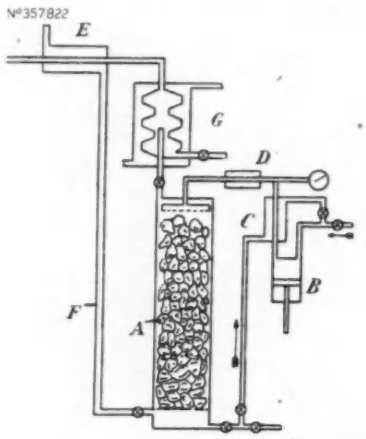

pressure of 250 atmospheres and a temperature of 450 deg. Cent., the tar is supplied by the pump at a temperature of from 450 deg. to 480 deg. Cent., and a pressure of 500 atmospheres or more. The products from the chamber A pass out through the dephlagmator G and the heat exchanger E. Any unconverted portions of the tar accumulate in the bottom of the chamber and are returned to the circuit through the heat exchanger C. Any free hydrogen in the gases is recovered by a freezing process, and is used again.—*October 1st*, 1931.

MISCELLANEOUS.

356,795. June 6th, 1930.—IRON CASTINGS, The Ford Motor Company, Ltd., 88, Regent-street, London, W. 1.

This invention is put forward in connection with valve tappets for internal combustion engines, and is said to provide a very cheap piece, considering its wearing qualities. The tappets are cast in a chill mould, as shown, which makes them very hard and difficult to machine. The quality of iron preferred contains from 2·5 to 2·9 per cent. of silicon, a maximum of 0·1 of sulphur, 0·42 to 0·48 per cent. of phosphorus, 0·6 to 0·8 of manganese, and from 3·4 to 3·7 per cent. of carbon. After casting, the tappets are heated to from 1700 deg. Fah. to 1750 deg. Fah. and

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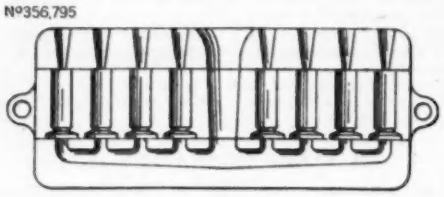
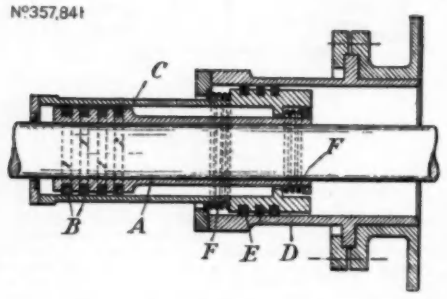


allowed to cool in air, which results in a hardness on the Brinell scale of 228. They are then machined and finally heated to 1650 deg. Fah. for about ten minutes and quenched in oil at atmospheric temperature, which gives a hardness above 400 Brinell. Any very precise dimensions may then be produced by grinding.—*September 7th*, 1931.

357,841. November 12th, 1930.—PISTON-ROD PACKINGS, C. B. MacDaniel, 4, Milosa Velikay ulica, Belgrade, Jugoslavia.

It is claimed that this arrangement of piston-rod packing is suitable for unusually high steam pressures. It takes the form

No357,841



of a sleeve A fixed on the rod and provided with spring rings B. Surrounding this sleeve there is a tube C, which, in turn, can slide in the casing D and is made tight by the rings E. Helical springs are provided at F F to cushion the shock on the tube as it is reciprocated with the piston-rod.—*October 1st*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHEMICAL ENGINEERING GROUP.—Burlington House, Piccadilly, W. 1. "Platinum," by Mr. Donald McDonald. 8 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Engineering Silver Solders," by Mr. E. A. Smith. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—At the Chamber of Commerce, 95, New-street, Birmingham. "Some Details of the Progress Reached in Forge and other Welding in Boiler Works Practice," by Messrs. E. W. Thompson and A. Jeavons. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Annual general meeting. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. "The Industrial Smoke and Grit Problem," by Mr. Ernest Clegg. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Engineers' Club, Albert-square, Manchester. "A Comparative Study of Some Properties of Pig Irons," by Mr. J. E. Hurst. Discussion. 7.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—At the Mining Institute, Newcastle-upon-Tyne. "The Care and Maintenance of the Industrial Steam Locomotive," by Mr. J. W. Hobson. 6 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, George-street, Glasgow. "Photomicrography," by Mr. A. Macdougall. 7.5 p.m. Council Meeting at 6.45 p.m.

MONDAY, NOVEMBER 16TH.

BRADFORD ENGINEERING SOCIETY.—The Technical College, Bradford. "Lubricated Bearings," by Dr. H. W. Swift. 7.30 p.m.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

TUESDAY, NOVEMBER 17TH.

INSTITUTE OF INDUSTRIAL ADMINISTRATION.—In the Lecture Hall, Institute of Hygiene, 28, Portland-place, W. 1. Paper, "Industrial Russia," by Mr. J. Fearn. Discussion. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Seagrave Club, Queen-street, Wolverhampton. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Discussion, "The Treatment of Sewage Sludge by Bacterial Digestion," by Mr. H. C. Whitehead and Mr. F. R. O'Shaughnessy. 6 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND. —39, Elmbank-crescent, Glasgow. "The Application of Low Temperature Coal Distillation to Modern Requirements," by Messrs. E. H. Smythe and E. G. Weeks. 7.30 p.m.

OLD CENTRALIANS.—At the Devereux Restaurant, Devereux-court, Strand, W.C. 2. Luncheon. 1 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London W.C. 2. Special meeting. "The Pressure Cable—an Advance in the Construction of High-voltage Cable Installations," by Messrs. M. Hachstadter, W. Vogel and E. Bowden. 8 p.m.

TUESDAY AND WEDNESDAY, NOVEMBER 17TH AND 18TH.

SOCIETY OF GLASS TECHNOLOGY.—In the King's Head Hotel, Sheffield. Refractories Committee, 4.30 p.m.; Standards Committee, 5.45 p.m.; dinner, 7 p.m.; Council Meeting, 8.15 p.m. Wednesday: In the Applied Science Department, The University, St. George's-square, Sheffield; visit to research laboratories, 10.30 a.m.; discussion on "The Future of Glass Melting," based on the Presidential Address by Mr. Edward Meigh; to receive and discuss the following paper, "Regeneration in Glass Furnaces," by Mr. T. P. Colclough. 2 p.m.

WEDNESDAY, NOVEMBER 18TH.

ILLUMINATING ENGINEERING SOCIETY.—In the Worshipful Company of Tallow Chandlers' Hall, 4, Dowgate-hill, London, E.C. 4. "The Tallow Chandlers' Company and their Craft," by Mr. R. H. Monier-Williams; "The Historical Development of Gas Lighting," by Mr. W. J. A. Butterfield; "The Early Days of Electric Lighting," by Mr. James Swinburne, F.R.S. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Metropole Hotel, King-street, Leeds. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Students' Meeting. Address by Mr. E. H. Ely. 6.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section. "Turbine Gearing," by Mr. W. Pratt. 7.15 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, S.W. 7. Meeting at 5 p.m.

ROYAL MICROSCOPICAL SOCIETY.—B.M.A. House, Tavistock-square, London, W.C. 1. Meeting at 5.30 p.m.

THURSDAY, NOVEMBER 19TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. "The Design of a Distribution System in a Rural Area," by Mr. F. W. Dickinson and Mr. H. W. Grimmitt. 6 p.m.

INSTITUTION OF MINING AND METALLURGY.—At the Rooms of the Geological Society, Burlington House, Piccadilly, London, W. 1. Discussion, "Notes on the Mica Industry in Bihar, India," by Mr. Brian G. Luff; "Models of Mines and Orebodies," by Mr. F. W. Armstrong. 5.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—In the Lecture Theatre of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Aircraft Vibration," by Mr. H. Constant. 6.30 p.m.

FRIDAY, NOVEMBER 20TH.

INSTITUTE OF CHEMISTRY.—30, Russell-square, London, W.C. 1. Fourteenth Streatfeild Memorial Lecture. "Recent Advances in the Fermentation Industries," by Dr. J. Vargas Eyre. 8 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Sixth Report of the Marine Oil Engine Trials Committee, to be presented by Eng. Vice-Admiral Sir George G. Goodwin. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Modern Pressed Brick Manufacture," by Mr. H. G. Brown. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. Discourse, "Oil and Petrol from Coal," by Dr. C. H. Lander. 9 p.m.

MONDAY, NOVEMBER 23RD.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Diesel Engines, I.," by Mr. H. R. Ricardo, F.R.S. 8 p.m.

TUESDAY, NOVEMBER 24TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE. —At the Grosvenor Restaurant, Gordon-street, Glasgow. Annual dinner. 6.30 p.m. for 7 p.m.

INSTITUTE OF MARINE ENGINEERS.—The Minories, London, E.C. 3. "The Work of Akroyd Stuart and the Development of the Oil Engine in which it is Carried On," Akroyd Stuart Award, 1931, paper, by Mr. Alan E. L. Chorlton. 6 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Works Progress," by Mr. H. T. Hildage. 7.30 p.m,

WEDNESDAY, NOVEMBER 25TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Engineers' Club, Albert-square, Manchester. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7 p.m.

NEWCOMEN SOCIETY.—In the Hall of the Chartered Institute of Patent Agents, 1, Staple Inn-buildings, W.C. 2. Annual General Meeting. "Men of Straw: An Account of Surviving Straw Handicraft," with a practical demonstration, by Mr. T. B. Hennell. 5.30 p.m.

THURSDAY, NOVEMBER 26TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "The Casting of Tough Pitch Copper," by Mr. W. F. Brazener. 7 p.m.

FRIDAY, NOVEMBER 27TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, Westminster, S.W. 1. "Progress in the Design and Construction of Static Transformers," by Mr. D. W. McJannet. 7.30 p.m.

MONDAY, NOVEMBER 30TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Diesel Engines, II.," by Mr. H. R. Ricardo, F.R.S. 8 p.m.

WEDNESDAY, DECEMBER 2ND.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, Londo , W.C. 2. "The Development of Lighthouses," by Mr. D. Ala Stevenson. 8 p.m.

FRIDAY, DECEMBER 4TH.

JUNIOR INSTITUTION OF ENGINEERS.—In the Lecture Theatre of the Royal Society of Arts, John-street, Adelphi, W.C. 2. Presidential Address by Dr. S. L. Pearce; presentation of Medals and Awards by the Retiring President, Colonel Sir Henry G. Lyons. 7.30 p.m.

MONDAY, DECEMBER 7TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Diesel Engines, III.," by Mr. H. R. Ricardo, F.R.S. 8 p.m.

WEDNESDAY, DECEMBER 9TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Trueman Wood Lecture, "Roads and Road Transport," by Sir Henry Maybury, G.B.E. 8.30 p.m.

FRIDAY, DECEMBER 11TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Oxygen Machine Cutting," by Mr. C. G. Bainbridge. 7.30 p.m.